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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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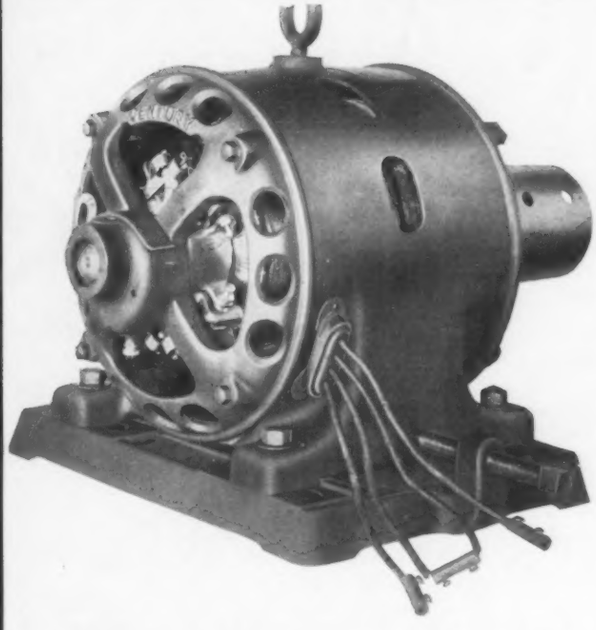

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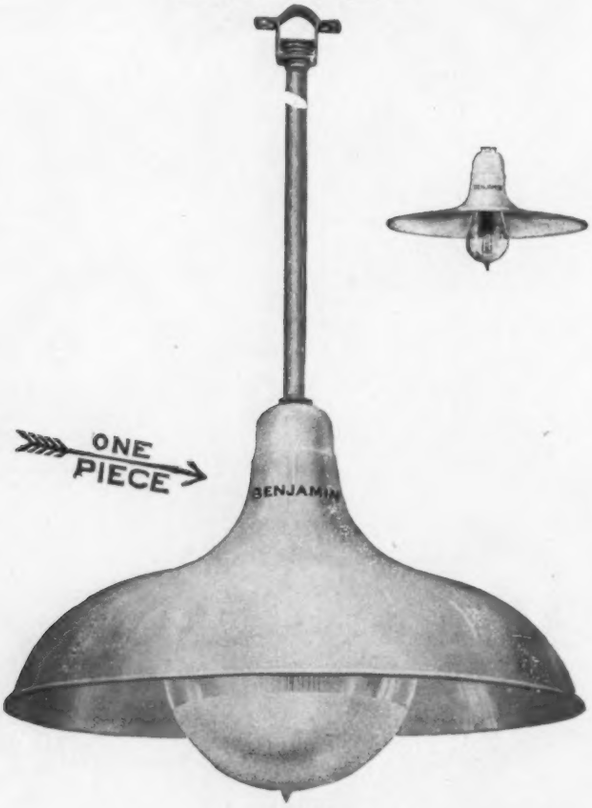
Alphabetical Index to Advertisers, Page 8. Where to Buy It in the West, Pages 9, 10, 12.

Have You Ever Thought of What it Costs?

Reflector Sockets



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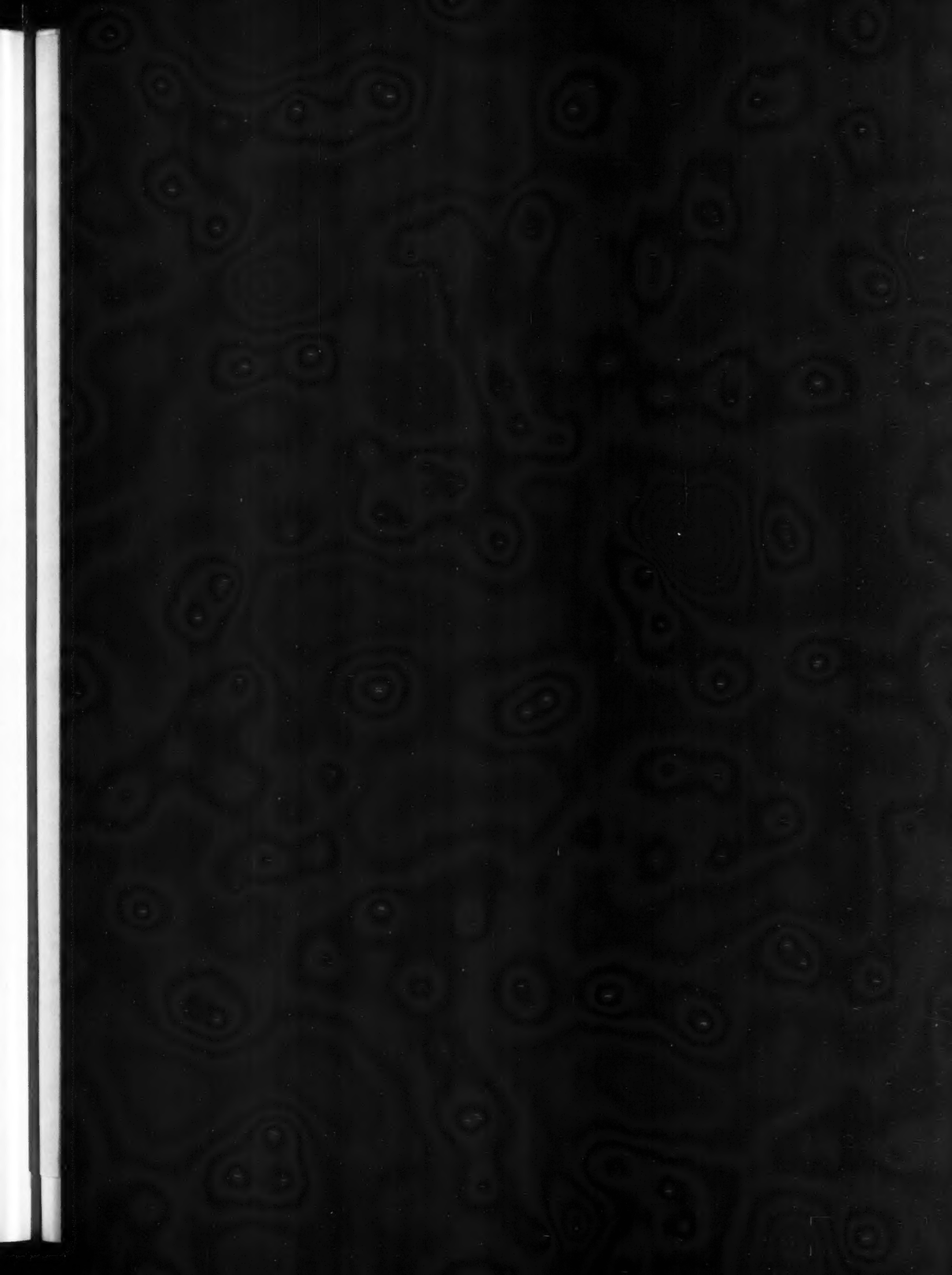

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RELIEF MAP OF CALIFORNIA

SHOWING PRESENT AND PROPOSED TRANSMISSION LINES OF PACIFIC LIGHT AND POWER CORPORATION

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"The Snow-Capped Sierras."

THE PACIFIC LIGHT AND POWER SYSTEM

BY ROBERT SIBLEY.

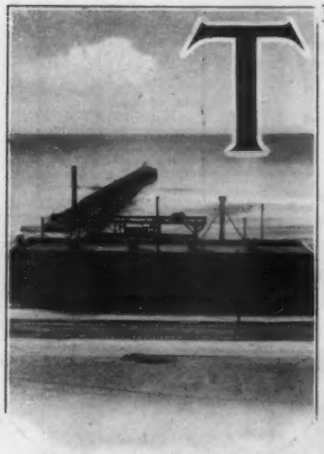
"Scaled the Lofty Summits."

ONLY those who have scaled the lofty summits of the snow-capped Sierras, seen the massive barriers of rock crowned with wind-worn timber, and noted the tantalizing rays of the early morning sun sifting through the rocky pinnacles and casting the deep, clear contrasts in the canyons below, can realize what exquisite beauty really is. Yet it is not for the purpose of picture beauty that this article is written, but rather to set forth the wonderful power's latent in Nature's bountiful waterfalls which suggest a beauty almost beyond a description in words. This beauty is not that of a picture formed for the admiring eye, but rather a beauty realized from a consideration of Nature and her evident endeavors to relieve mankind from his crushing burdens, a beauty which not only delights the eye but touches the heart when we contemplate Nature's bountiful provision for man. Our theme, then, is the waterfall

A score of years have not yet passed since Baldwin and Burt constructed the longest distance transmission line in the world, conveying electricity from San Antonio Canyon in Southern California to the city of San Bernardino, distant to the east some twenty miles. What awe and wonder seemed to overcome visitors to this plant in former days. Yet how few years have passed, and now we find electrical energy transmitted distances running into the hundreds of miles, and voltages in the hundreds of thousands. Even now that little power plant, but a few years ago one of the wonders of the world, has been so far outstripped in the advance of the art that, like Goldsmith's "Deserted Village," it stands silently alone in the canyon where formerly it was "monarch of all it surveyed." Its water wheels lying unshrouded to the cool night air and its concrete foundation-work, robbed of its former ornamental covering, are silent but impressive monuments of the almost inconceivable advance of modern achievements in the engineering art.

It seems but fitting now, in the beginning of the twentieth year since the advent of the original installation in San Antonio Canyon that we should in a measure detail the accomplishments of one of the typical power installations of the West, the reason for this gigantic development and its market.

PACIFIC LIGHT & POWER CORPORATION.



Redondo Pumping Plant.

THOSE gazing down Main street at Los Angeles during certain hours of the day and seeing one solid mile of congested traffic, realize in a small measure where and how such wondrous powers are utilized, and when we know that this has grown into its present large proportions in a short decade, we hesitate to prophesy what the demand for this power may be in the decade ahead.

Again we wander through the manufacturing district of greater Los Angeles and see its rapid upbuilding and the constantly increasing cry for more power, once again we hesitate to answer the question as to where available power will come from to satisfy the demands of the future. But it is not until we pass up and down through the fertile orange groves, across the productive fields of produce and then again look upon the thousands and thousands of acres of arid lands, that we can form a small conception of what the future demand for power will be in the electrically operated irrigation systems for such vast empires of latent possibilities.

Borel Canal Intake.

The properties of the Pacific Light & Power Company comprise seven water power and three steam electric generating stations.

The total hydroelectric output for the year 1911 was 68,744,691 kilowatt hours, 47,826,062 kw. hrs. being generated at Borel, 9,921,400 at Mentone, 12,277,578 at Azusa, 4,299,440 at Sierra, 353,803 at Highgrove and 728,714 at Pedley. The steam generation was even more remarkable and indicates the need for greater hydroelectric development, the total during the year being 139,462,369 kilowatt hours, 126,377,089 kilowatt hours being generated at Redondo, 11,272,703 at Central Avenue Station, and 1,644,257 at the Third Street Station. The Oil Wells Station produced 168,320 since this plant was connected to the system, September 20, 1911.

Trunk power lines of the company comprise 433 miles, 127 of which are double circuits of three-phase installations and operate under 60,000 volts, while the remaining 206 miles are also double circuits and three-phase installations but operate at 15,000 volts. In addition to the trunk lines there are 291 miles of distributing lines which make a net-work of the cities of Southern California. Distribution is carried on at 2400 volts.

The company operates 15 miles of single track street railway connecting the cities of Ontario, Claremont and Pomona. These cities are situated in the heart of the citrus belt. They are growing rapidly and their civic pride is of high order.

A total of 3505 arc lights are supplied for streets, 3203 of which are in Los Angeles, 275 in San Bernardino and 27 in Huntington Park. A number of towns and cities are supplied with incandescent lamps. In fact a total of 2811 lamps are distributed as follows: 726 50-watt, 6-6 ampere, series lamps serve Hollywood, 544 South Pasadena and 346 Alhambra. At Alhambra there are also 150 forty-watt Mazda lamps, while 50 series carbon lamps are to be found at Covina; 1095 100-watt, 110-volt multiple lamps assist streets of Los Angeles in maintaining their record among the best lighted in America.

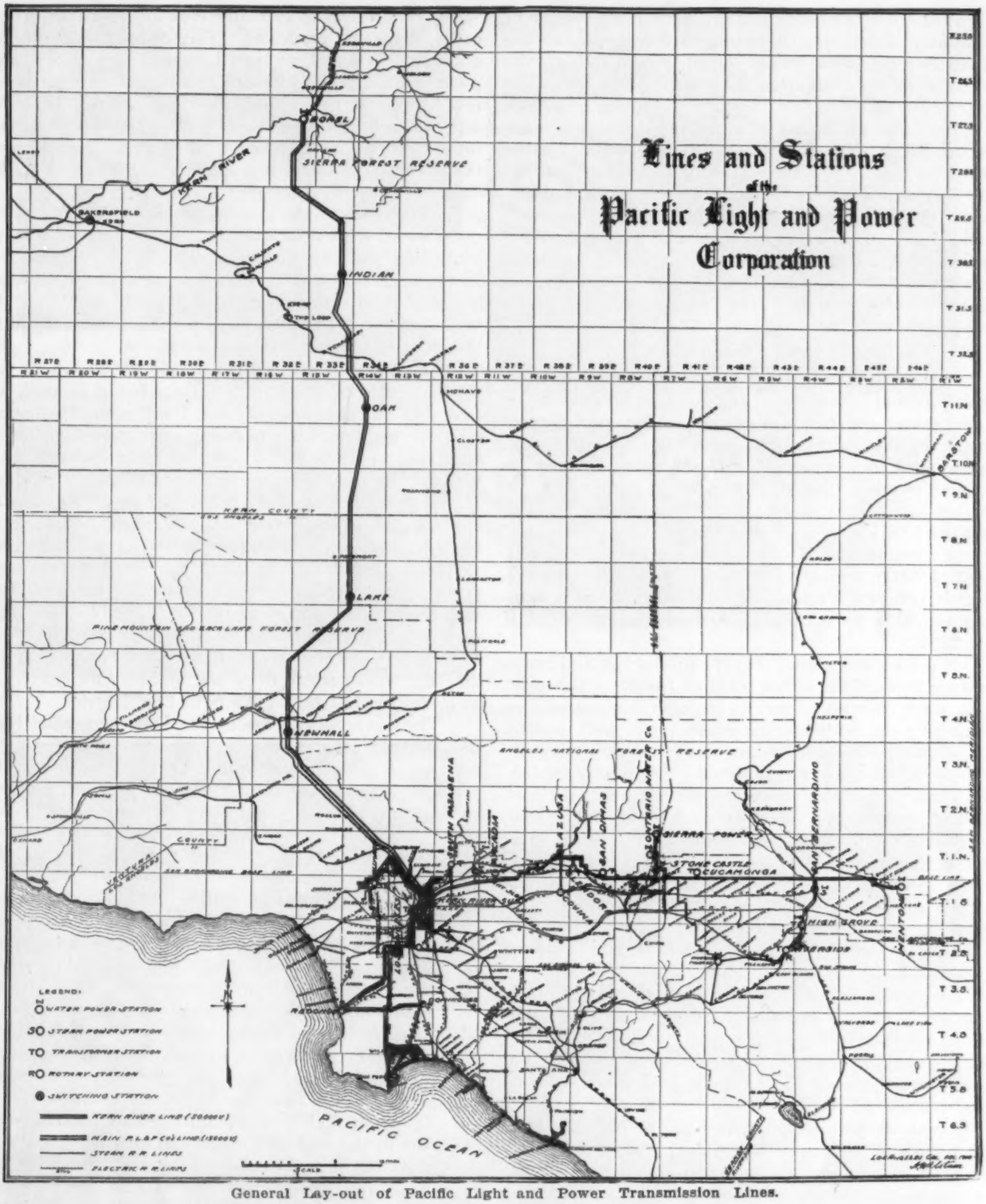
About 85 per cent of this power supplies the world-famed electric urban and interurban systems of Los Angeles and of Southern California; 11,000 consumers get their electrical power supply from the gigantic network owned by the Pacific Light & Power Corporation.

A world of industries are grinding out their supplies for the growing communities in Southern California. These industries are impelled by electrically supplied power from the Pacific Light & Power Corporation. Ninety separate commercial products are being electrically energized from this source. Amusement parks, breweries, can factories, chemical plants, electric railways, electric automobiles, laundries, macaroni factories, mines and four score other industries feel its influence.

The installed capacity of the hydroelectric plants of the Pacific Light & Power Corporation totals 14,415 k.v.a, of this enormous total, 10,000 is installed at the Borel plant, 600 at Riverside, 1500 at Azusa, 600 at Sierra, 1500 at Mentone, 150 at Highgrove and 65 at Stone Castle. The installed capacity of the steam plants on the other hand totals 56,250 k.v.a., of which 45,000 is at Redondo, 2550 at Third Street Station, 8550 at the Central Avenue plant and 150 at the Oil Wells. Thus there is installed in both hydroelectric and steam power plants a total of 70,665 k.v.a.

Speaking in common parlance this enormous generation of energy amounts to 95,000 electrical horsepower. Such totals give but a faint conception of their gigantic proportions. Perhaps

Snow Enroute to Kern River.



General Lay-out of Pacific Light and Power Transmission Lines.

the layman can conceive a clearer idea of this performance when we say that a string of horses, six abreast and thirty miles long, working eternally could scarcely drive the powers supplied from such a source.

Nine cities and towns are supplied with electric energy. These cities have an aggregate population of over 400,000 and comprise the following municipalities: Los Angeles, San Bernardino, South Pasadena, Corona, Covina, Glendale, Alhambra, Azusa and Tropico.

It is interesting to follow the details of this remarkable system and to see its interconnections from the Borel plant six score miles on the north to the distributing network interlinking the prosperous cities of Southern California.

The double pole line of the Pacific Light & Power Corporation with its cleared right-of-way extending from the Borel station scores of miles to the south into Los Angeles presents a neat and trim appearance as it winds its way over the rolling foothills. This double form of installation assures continuous service at all times in the operation of the transmission line.

Again, from the point at which the high tension

lines leave the Redondo station, with their cluster of aluminum electrolytic lightning arrester cells, to the intensified net-work at the Third Street station, the installation work involved in stringing the wires has interesting features.

Here and there may be noted the systematic manner in which the wires stretched in a vertical plane are dead ended, and then quickly the scene changes and they take a horizontal swing for the remaining distance. The Dominguez substation, eleven miles from Redondo, presents an example of this phase of distribution design. Again, when the wires, winding their way overhead suddenly disappear vertically into a 15,000-volt underground cable, the layman is puzzled and perplexed by the manner of its accomplishment.

The Big Creek Plant.

The striking feature of the foregoing compilation of data is that which shows the great preponderance of steam power generation compared to the hydroelectric output of the Pacific Light and Power Corporation. Let us for a moment examine the comparative costs of the two as taken from the books of the corporation for the eleven months ending November 30, 1911. The cost per 1000 kw. at the Redondo steam plant was $3.72 for production and $0.28 for maintenance, making a total of $4.00, while, on the other hand, their hydroelectric generation amounted to only $0.33 for production and $0.58 for maintenance, thus making a total of but $0.91.

It is seen at a glance that the production and maintenance costs of the steam plant on the basis above set forth were over four times as large as the cost of generation by the hydroelectric plant. It is well to note, too, that the Redondo steam plant was only recently completed and may be considered a thoroughly modern and efficient plant in every respect. It burns oil fuel, which, on the Pacific Coast, is much cheaper than coal. Of course the hydroelectric plant, usually being some distance from the market, requires added transmission cost. In the case of the Borel plant this amounted to only 37 cents per 1000 kw. and the average of all transmission expense of the Pacific Light and Power Corporation for the eleven months period was 30 cents per thousand kw.

It is to save this enormous operating expense—in a word, to meet a market within itself—that the corporation is now constructing its present extensive hydroelectric development—a development which will at once place it among the foremost hydroelectric enterprises in the world.

Some sixty miles to the east of Fresno, California, are found the waters of Big Creek, which drain from the high Sierras with their eternally snow-capped pinnacles. The waters of Big Creek and Pitman Creek, a tributary, are being diverted into reservoirs of 102,159 acre feet capacity which require three dams of 160 ft., 90 ft. and 75 ft. height. This water will be utilized first in plant No. 1, which is being installed at the foot of Kerckhoff Dome, with static head of 2,100 ft. and and installed capacity of 60,000 kilowatts. After passing plant No. 1 the water is again being used in plant No. 2, on Big Creek, about four and one-half miles below Kerckhoff Dome. The static head at this plant is 1,900 ft. and the complete installed capacity will be 60,000 kilowatts. Additional water is added to that passing through plant No. 1 by diverting some of the water which rises in Pitman Creek below the diverting canal in the big resorvoir. This compensates for the difference in effective head between plant No. 1 and plant No. 2. Some conception of the storage in these reservoirs may be obtained from the fact that with the ultimate reservoirs full and discharging water at the rate of 300 second feet and with no water flowing into them from any source it would require a period of 170 days to empty the reservoirs.

These two modern twin giants, which are being constructed with sufficient capacity, as noted above, to force into the city of Los Angeles, 275 miles to the south, 120,000 kilowatts of energy, certainly constitute one of the most interesting hydroelectric developments in the world. Let us then go a little more fully into the details of the proposed construction.

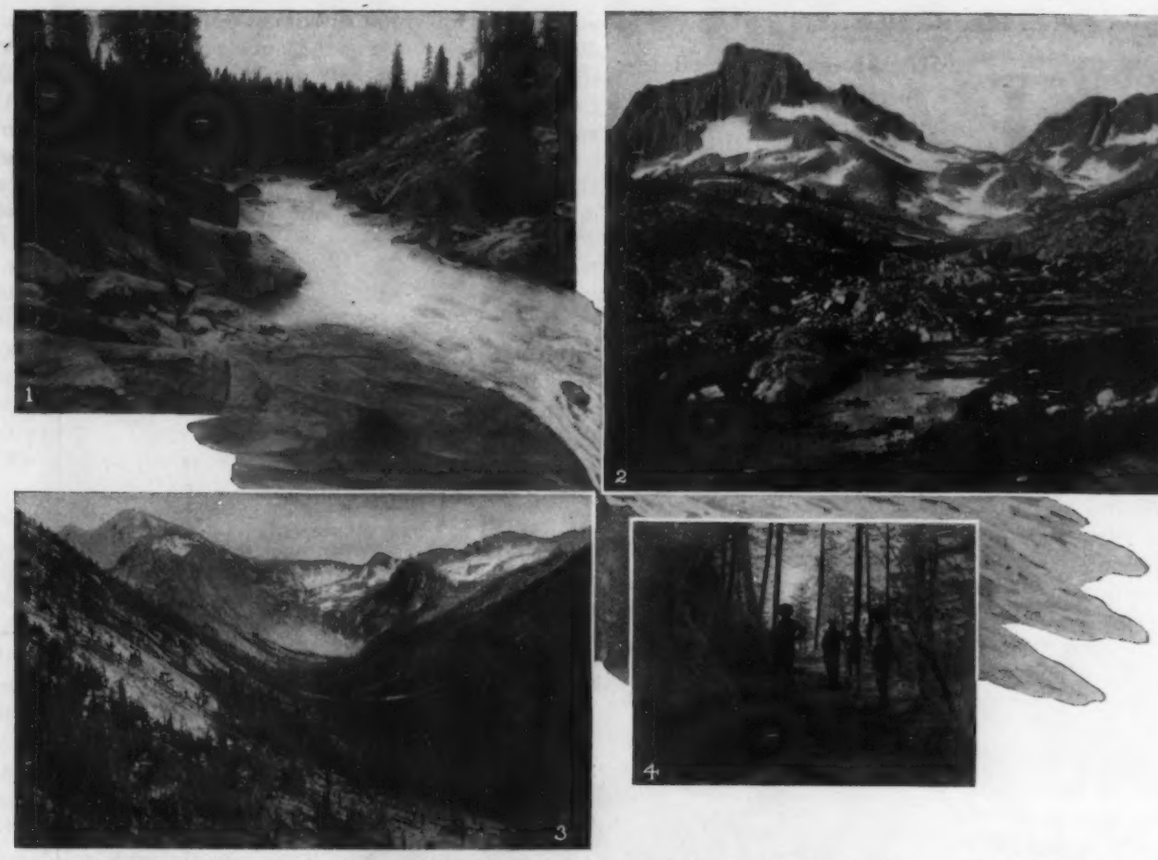
Beginning at the waters of Big Creek where the diversion works for plant No. 1 are being located, we find that the specifications call for the most substantial concrete dams known to engineering science. These dams are being built on solid rock bottom and sidewalls. The huge rock dome known as Mt. Kerckhoff is being tunneled and the solid rock walls lined with concrete. The water from the diversion works are to enter immediately into this tunnel and upon coming out to the forebay are to be taken by means of five steel pipes almost precipitously downward some 2100 feet vertical into the power house No. 1 below. The five units here to be installed, which have a capaciity of 11,000 kilovolts amperes each, together with like units at plant No. 2, are to be of the highest efficiency. as to deliver 120,000 kilowatts in Los Angeles.

The water wheels are to be of the tangential type and directly attached to the generating units just referred to. The power house inclosing these giant mechanisms is being built of steel structure, fire-proof throughout, all walls being of concrete filling Each power plant is being equipped with a 50-ton traveling crane in order to handle the most massive of the machinery.

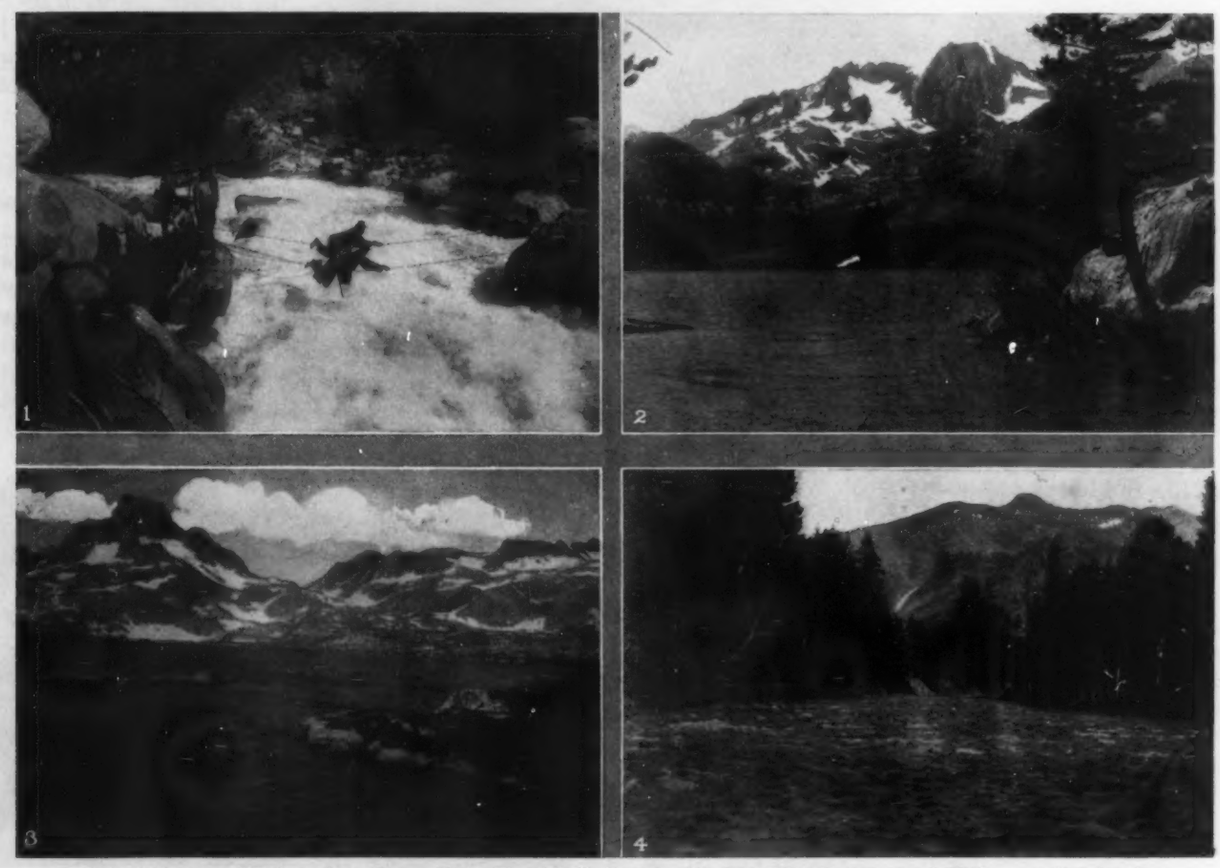
A jump of 1900 feet will be made by the waters in this journey. After the waters have entered the settling basin just referred to they will then be taken through a tunnel 3½ miles long, cement lined throughout. Upon emerging from this tunnel once again they will continue in their precipitous journey to power plant No. 2. As the entire canal work is being built through solid rock tunnels, concrete lined, it is thought that no maintenance charge will ever have to be made for this part of the structure.

The Big Creek power plant sites are located some 60 miles to the east of Fresno, California. A railroad is now being built 50 miles to the eastward with the proposed terminus immediately at this power plant. This assures simplicity in transportation of the heavy machinery necessary for this gigantic installation.

The 275 miles of transmission line will consist of a double set of steel towers, each tower supporting six wires. At each 40 or 50 mile interval along the line, lightning protective apparatus, together with complete cross-over switches will be installed. Thus will be presented to the engineering world one of the most pliable transmission systems ever built. The current will be transmitted at 110,000 volts and the frequency will be 50 cycles.



(1) Intake of Big Creek Project. (2) The Perpetual Snows in the High Sierras. (3) Typical Scene in Big Creek Drainage. (4) Constructing Roads to Big Creek.



(1) Gathering Engineering Data Near Kerckhoff Dome. (2) The Wild Lakes, Head Waters of Big Creek. (3) 11,000 ft. Above the Sea. (4) A Portion of the Proposed Gigantic Reservoir.

THE BOREL PLANT.

The Borel Canal.

THE advent of the oil industry in California made many engineers skeptical as to the future of long-distance hydroelectric transmission plants. Yet in spite of the fact that the annual output of California oils now sums the unbelievable total of 75,000,000 barrels, the faith in the hydroelectric installations of California is today more firm and unshakable than ever.

From the station of Caliente, on the main line of the Southern Pacific Railroad, the visitor is met with powerful automobiles and conveyed over steep grades neatly trimmed to perfect evenness. After enjoying some thirty miles of unsurpassed mountain scenery, he arrives at the summit of the crest, from which he is enabled to see, in the beautiful valley below, the Kern River and the canal for the Borel plant of the Pacific Light & Power Company.

Borel Canal Leaving Tunnel.

Drawing still nearer he is pleasantly surprised at the even surface with which the artificial waterway conveys its burden. Upon arriving at its brink the exquisite workmanship with which it has been finished is noted. The entire surface of the canal is of concrete grouting, 4 inches thick, composed of one part Portland cement, two and one-half parts sand, and five parts of gravel. This grouting is evenly faced with a plaster coating composed of one part Portland cement and two parts of fine sand, which makes a neat workman-like finish. The conduit is so large that two automobiles may pass abreast in its bottom, and the extreme width across the top spans some fifty feet.

Careful water records are continually being turned off by the automatic registering devices near the intake and lower end of the canal. These devices show the rise and fall of the waters of the river during the different hours of the day. A remarkable feature is that throughout the eleven and one-half miles of conduit, seepage and evaporation cause the loss of only three to four second feet of water. From carefully compiled government data the carrying capacity of a water-way of these proportions, practically diminishes by this amount due to evaporation alone. In fact as one goes from one end of the canal to the other, the exceedingly tight-fitting parts seem to be one of the most striking features.

Painstaking care has brought about this condition. During the low water period of each year the wooden flume work is carefully overhauled by calking the seams between the boards with oakum, and by pouring hot oil upon the oakum after this painstaking work is done. A casual glance at the illustration will show the manner of accomplishing this by boats. Canal walkers are daily kept patrolling the brink of the waterway, and, at a number of points along the line, iron pipes with perforations in their sides have been sunk through the berm of the canal in order to determine whether any stray seepage is taking place. The illustration shows one of the canal walkers collecting his daily data along the brink of this conduit.

The most striking feature of the artificial waterway is the trestle one-third of a mile long spanning the Kern River. The substantial concrete piers show at a glance the permanency of the workmanship, and the perfectly dry supports show the non-leakable compactness of the flume itself. The canal conveys 600 second feet, or in the parlance of the days of '49, it carries 30,000 miners' inches of water.

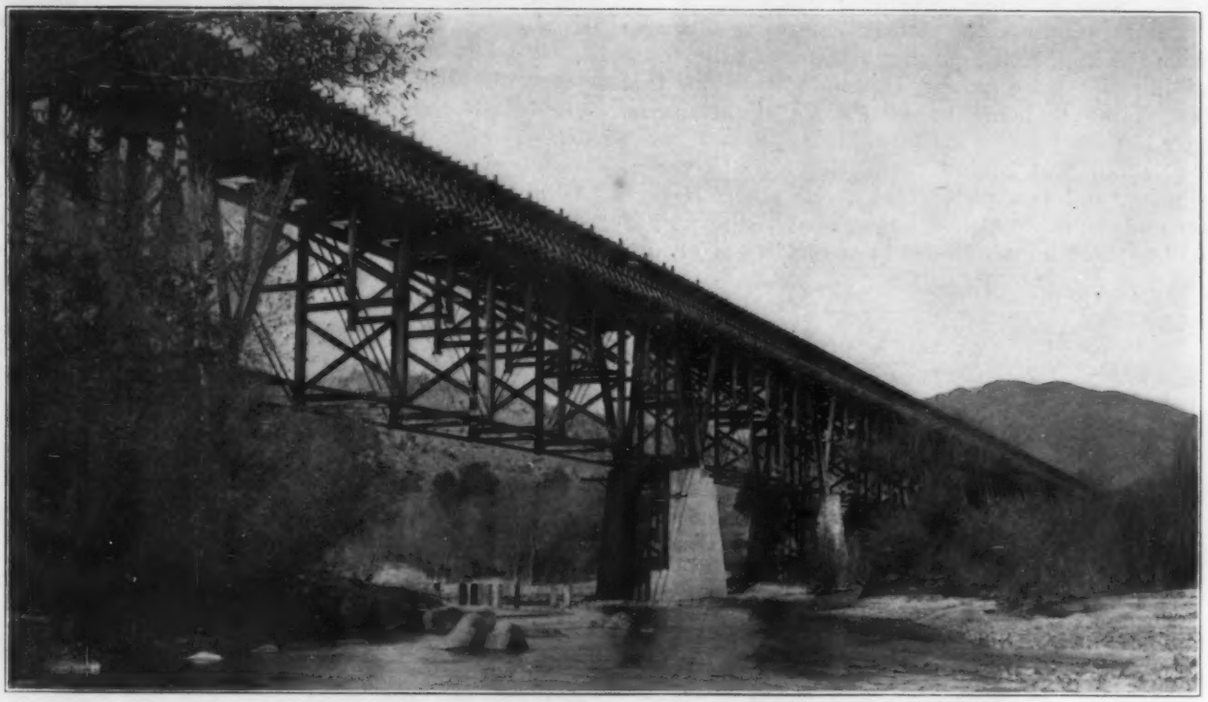
Upon walking through one of the flumes a full grown man, like the pigmies in Gulliver's Travels, is overcome by his comparative insignificance. The concrete-lined tunnels encountered along the line afford a pleasant variation in the design of workmanship and give added pleasure as one stoops to observe the evenness through and through to daylight on the other side.

The Company, ever anxious to improve this waterway, has just completed a cut through solid rock some forty feet deep at the highest point, in order to secure permanency in the future by doing away with certain unstable flume work previously encountered.

The intake at Kernville, some two miles above the forking of the river, is interesting. The settling basin at the entrance, 200 feet in width, assures that through the headgate one-half mile below, clear water alone will pass. The carefully constructed spillways along the line, together with the final settling arrangements at the forebay put the finishing touch in securing the cleanest, purest water for the busy wheels below. When one is perched upon the forebay, some 250 feet above the power house, he discovers a pleasing sight as he follows with his eye the five securely-fastened penstock pipes in their drop to the power house below.

Hauling Machinery

The comfortable and picturesque buildings for the attendants may be seen in the distance, and he knows that within the operating house team work of the highest degree is being developed. In descending along the pen-stocks, even the most



The Borel Canal Crossing Kern River.

The Borel Installation.

casual observer would notice the delicate adjustment of the relief valves which respond to the careful governing at the Redondo power plant a hundred and fifty miles southward.

Before entering the power house the danger sign on the improved lightning arresters in the house adjoining the main power station warns one that 60,000 volts are being used to force the electrical energy 140 miles to the southward.

A small foot bridge spans the Kern River at this point, and two photographs, one taken at high water and the other at low water, give a striking picture of nature's bountiful supply of this powerful fluid

The drainage area from which the Kern river receives its supply comprises the grandest and most ideal met with in hydroelectric installations of the West. Mt. Whitney, towering to a height of 15,000 ft. stands at the head waters of this picturesque river, a silent but impressive sentinel whose duty is that of seeing to it that an abundance of melting snows is supplied to replenish the dry areas below in the height of summer and in winter to store away a bountiful portion for the arid season of the year ahead. A hundred canyons trail their way up toward the summits of the high Sierras and eventually lose themselves in this area of perpetual snows. This hun-

(1) Overlooking the Flume. (2) The Relief Valves at Borel. (3) Gathering Seepage Data. (4) The Foot Ridge at High Water. (5) The Foot Ridge at Low Water.

in the proper seasons. A weir stretched across the tailrace below the power house indicates that careful data are being continually collected for the operators' use.

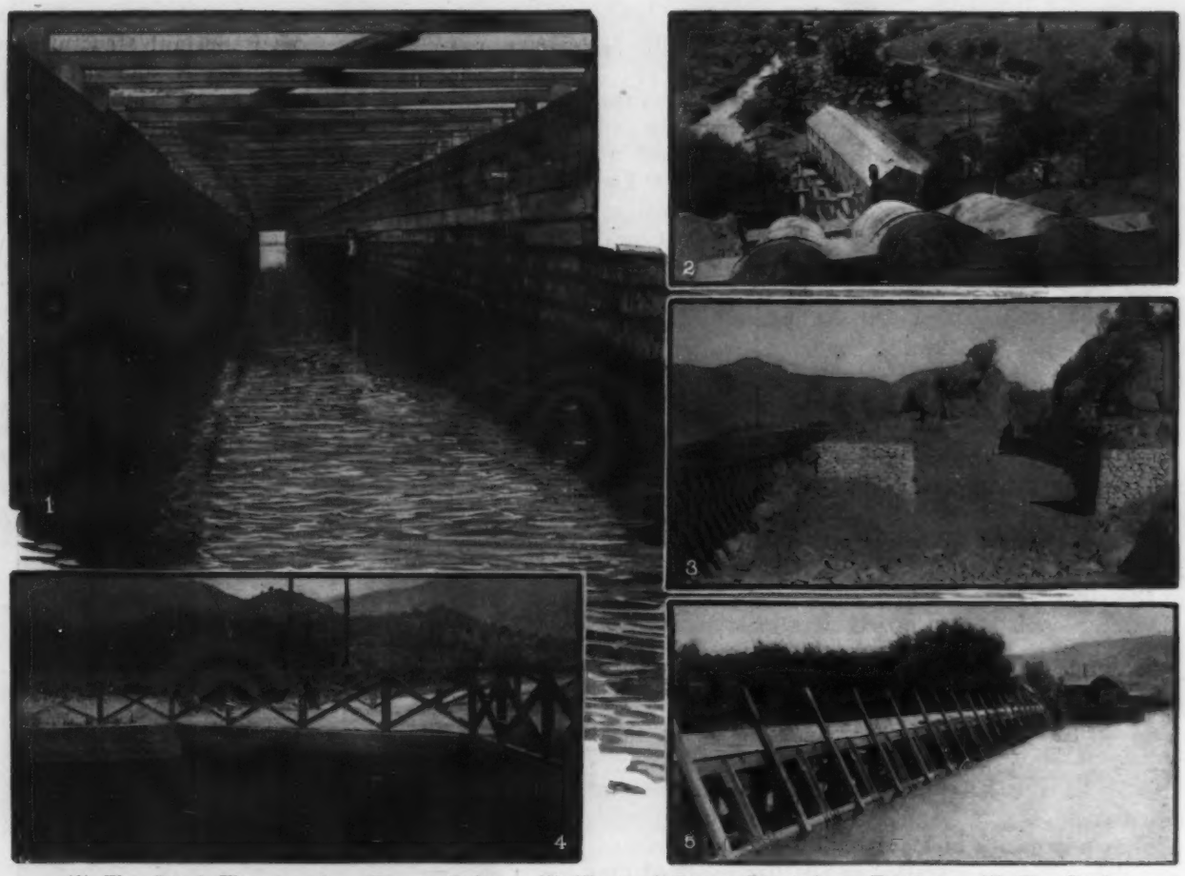
Within the main station powerful Pelton-Francis water wheels, showing by actual test the remarkable efficiency of 85½ per cent, give a faint conception of the conservation of water energy being developed in the plant. The switchboard with its complete modern apparatus shows painted upon it the complete wiring system, thus assuring safe operation even at the most critical and exciting moments.

The esprit decorps developed at this station is perhaps the most remarkable of any in the state. The young ambitious attendants, bedecked in their neatly lettered caps and sweaters, show at a glance that the "B" indicates to them not merely "Borel," but everything that is best in industry and attentive care.

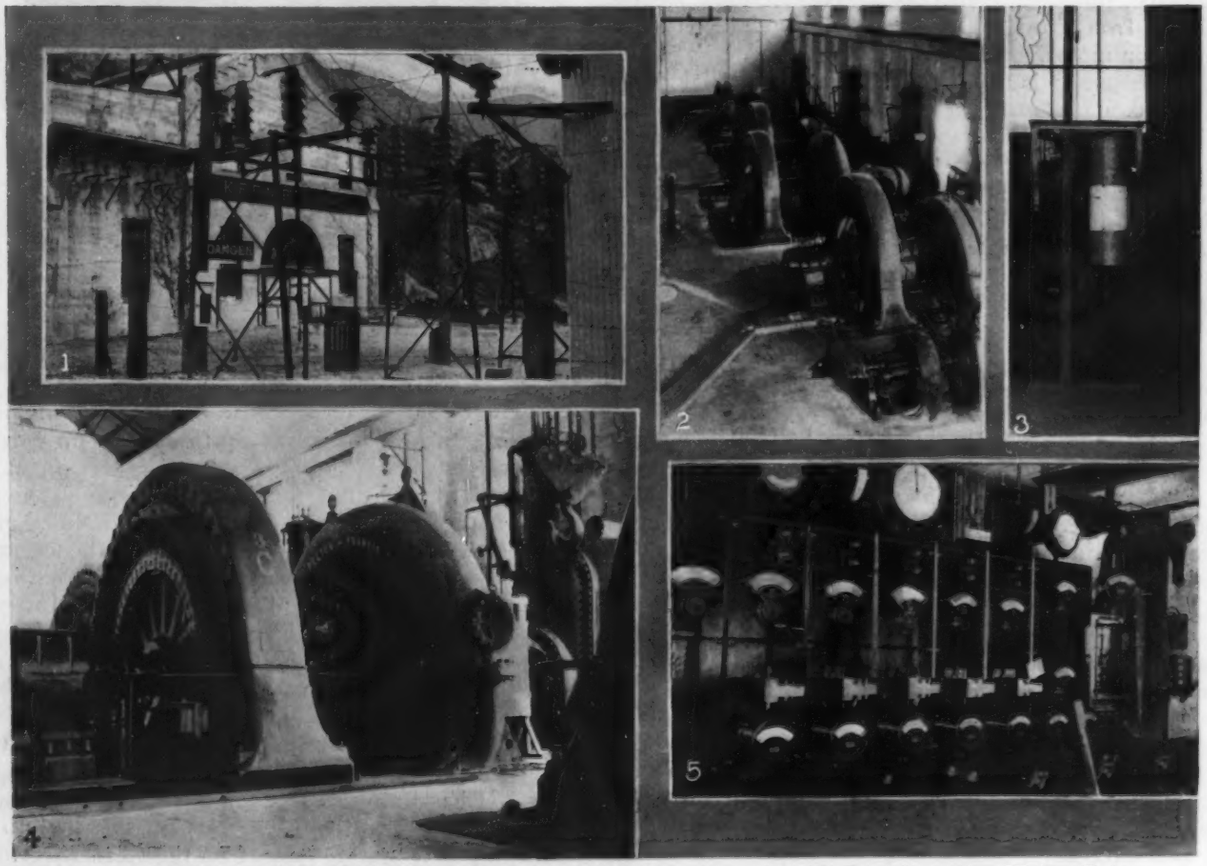
dred-headed monster assures to the Borel Plant an even and continuous supply of water at all seasons of the year.

The present remarkably high efficiency obtained from the Pelton-Francis water wheel installation in the Borel plant above alluded to was not obtained without much study and careful design. The company formerly had five Girard turbines but now after many careful tests, it is found that a great saving in power generation can be made by more modern ideas, consequently the plant is being overhauled and there is being installed four additional units similar to the 2860 kilowatt Pelton-Francis turbine now in operation at Borel.

These five water wheel units are being set on concrete foundations laid on bed rock which is uncovered about 15 ft. below the surface. The wheels discharge the waste water into a draft tube which conveys its



(1) The Borel Flume and a Human Being. (2) View. of Power Plant from Forebay. (3) The Rocky School House Cut. (4) Reinforced Concrete Bridge over Borel Canal. (5) Head Works on Kern River.



(1) Electrolytic Lightning Protectors. (2) Generating Units at Borel. (3) Recording the Water Data. (4) The Efficient Pelton-Francis Installation. (5) The Switchboard at Borel.

burden to the river below. Thus is every available source of energy made use of before the waters finally continue on their journey down the Kern River.

Five generators direct connected with each of the water wheel units are installed in the power house and occupy one side of the building from end to end, as shown in the illustration. Each machine is a 2000 kw. revolving field, three-phase, 50 cycle, 2200 volt, Bullock generator and operates at 230 revolutions per minute. The fields of these generators are excited by direct current from two 150 kw., multipolar, 125 volt Westinghouse generators which revolve at 550 revolutions per minute. These are driven independently of the main generators by two 30-inch Victor water wheels and thus is assured a constant supply of field excitation in case of an emergency. The governors used are of the Lombard type, five for the main and two for the exciter units. Those in the former case are known as type B and in the latter, type F.

The transformer room in which the bus gallery is located is built on the side of the main building away from the river. Here we find fifteen 750 kw. oil insulated, water cooled, step-up, General Electric transformers which operate for 50 cycle, 2200 to 60,000 volt current. The six panel switchboard on one side of the power house in a recessed raised gallery is equipped with one 15,000 volt, and 13-60,000 volt air controlled, oil switches—all of the Kelman design.

As an instance of the many modern conveniences installed at Borel may be cited the ice plant here found which has a capacity of from 1000 to 1500 pounds of ice per day. This is installed in the basement of the power house and consists of one upright ½-ton capacity ammonia compressor manufactured by the Risdon Iron Works. It is driven by a 5 h.p. type C induction motor.

The power house building is a substantial structure and consists of concrete on a concrete foundation with steel trusses and corrugated iron roof. The exterior dimensions of the power house are 64 ft. x 168.5 ft. The altitude above the sea at the power house is 2423 ft., while that of the forebay or reservoir is 2656 ft. Current is generated at 2200 volts and then stepped up to 60,000 at which voltage it is transmitted into Los Angeles.

Canals.

For the first eight miles the water is conveyed by means of a canal 29 ft. across the bottom, 49 ft. at the top and 9 ft. deep, thus making a side slope 1½ to 1. The embankment is 10 ft. deep with the same side slope except in rocky cuts where they are trimmed 1 to 1. The grade or fall in the conduit is 1 in 5000, with the exception of the last five miles which has a grade of 2 in 5000. From this point on the canal is found to be 15 ft. wide at the bottom. When carrying 600 cu. ft. per second, the water is 7½ ft. deep and under these conditions has a velocity of 2½ ft. per second. As has been previously touched upon the canal is lined on the sides and bottom throughout its entire length with a cement concrete grouting.

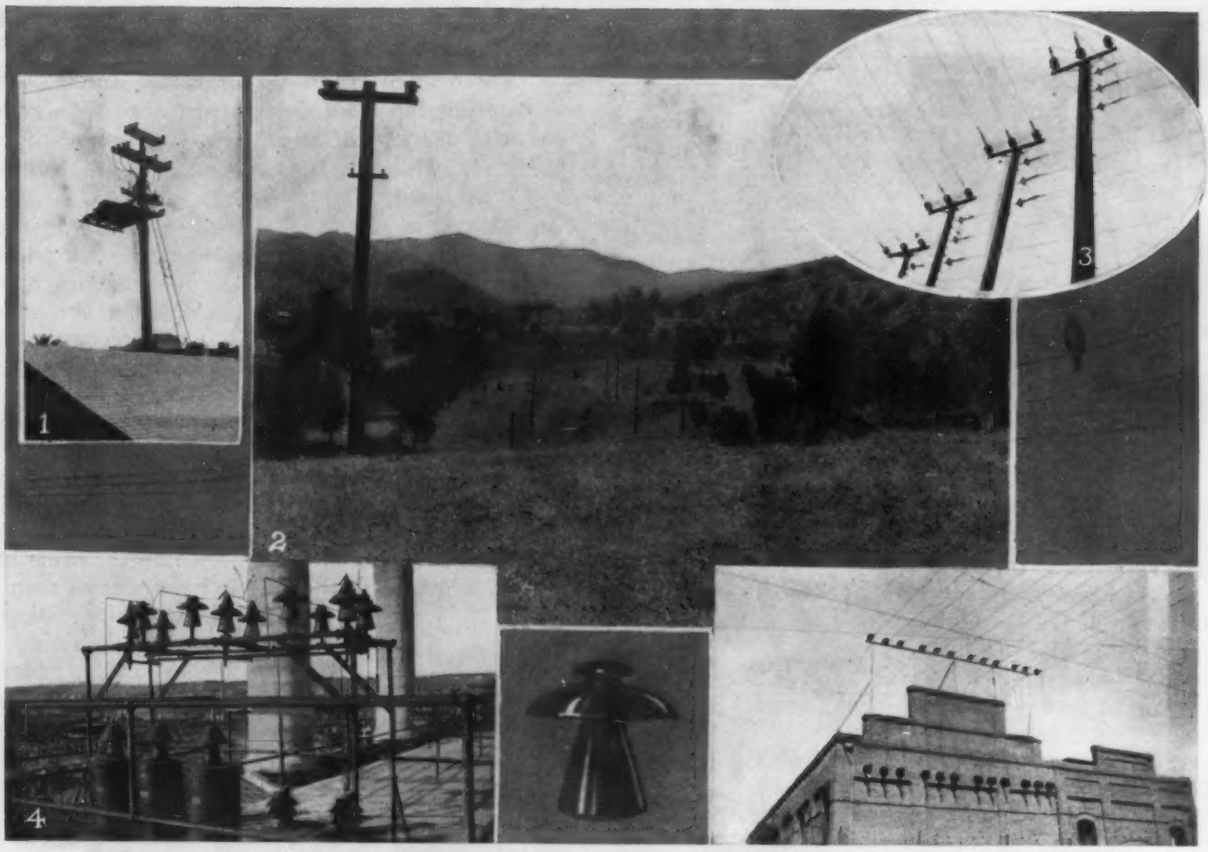
The four tunnels along the conduit aggregate 1982 ft. in length. These tunnels are also lined with cement concrete, have interior dimensions of 10 ft. in width and 10 ft. in depth and are driven on a grade of 1 ft. in every 1000.

The crossing at the Kern River which, as stated above, is by far the most important structure on the line is 1855 ft., the trestle 1371 ft. and the four span bridge 484 ft. in length, carrying a flume 10 ft. wide and 8 ft. deep on a grade of 1 ft. in 1000. The bridge is of the combination type with trusses 18 ft. apart and 29 ft. deep resting on concrete piers which are built on bed rock 15 ft. below the surface of the ground. The top of the flume is 72 ft. above the water in the river. At the upper end of the crossing there is a tapering flume 45 ft. long and, immediately below this, is a waste way for emptying the canal water into the river. All joints in the flume are bevelled to admit calking with oakum upon which hot asphaltum is poured. In the flume sides beaded battens are carefully nailed below the joints in which the hot asphaltum is poured.

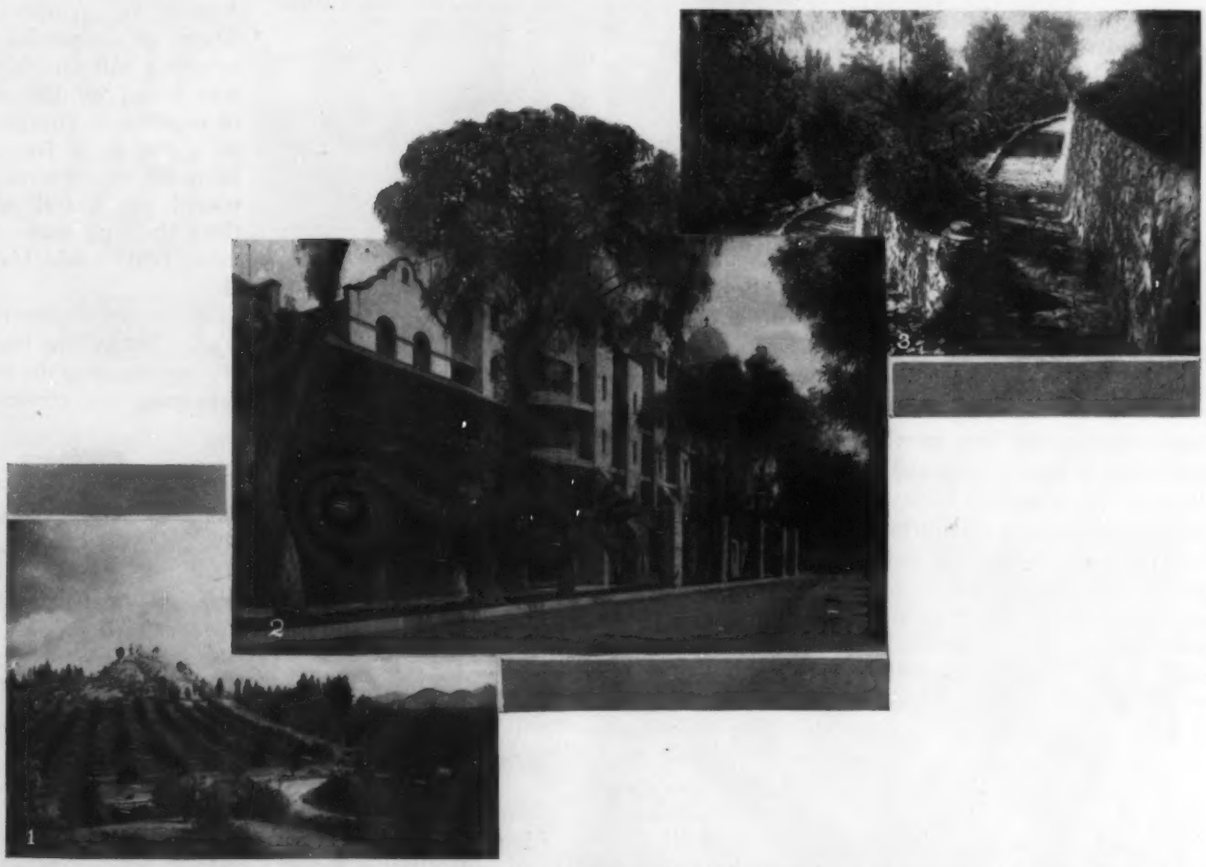
Borel Canal

The forebay, which is built on the steep mountain side as seen in the illustration, is merely an enlargement of the canal. It has been made permanent and substantial by blasting out the solid rock. It is provided with a sand box, screens, weir and sluice gates. The waste way discharges into a ravine thence to the river below the power house. This can be seen in the general illustration of the Borel station. It is interesting to note that the time taken for the water to pass from the head gates to the forebay is 6 hours, 20 minutes, the length of the water way being as stated above, approximately 11½ miles.

The Borel plant was installed the latter part of 1904 and put into operation December 31st of that year. It has been in continuous operation ever since, supplying power to Los Angeles, in addition to the Isabella power station located on the Kern River.



1. Change from Overhead to Underground in Transmission. 2. The Borel High-Tension Transmission Line. 3. Change of Transmission Lines From Vertical to Horizontal Plan. 4. Electrolytic Light Arresters—Redondo. 5. Transmission Lines Entering Kern River Substation.



1. A Typical Orange Grove—Southern California. 2. Thee Famous Glenwood Hotel at Riverside. 3. A Secluded Retreat Among the Orange Groves.

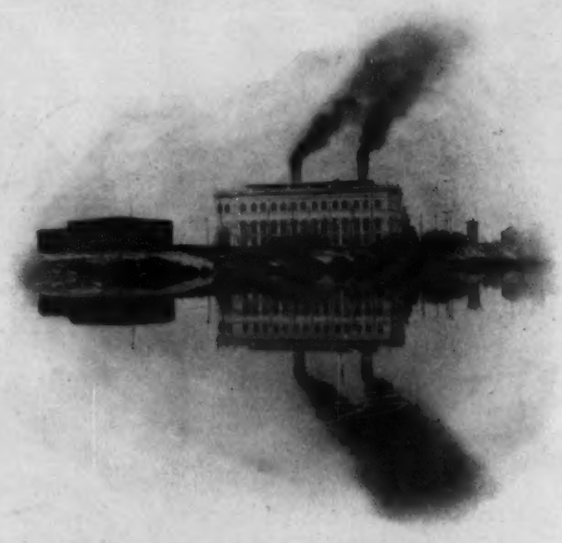
REDONDO.

Reciprocating Units.

N a careful study of the picture shown herewith, which gives in outline the Redondo installation, one is impressed with its lines of beauty and symmetry in design, but when one observes the structure more closely, its massiveness and stability—a fitting tribute to the industry it represents—outweigh all other considerations. The Redondo plant today presents features of design and cleverness of operation that may well be emulated by the central station fraternity at large.

The three huge concrete stacks rising 125 feet in elevation above the boiler room floor line, the three 50-inch steel pipes filled to the utmost with cool sea water which is constantly being returned back into the sea heated to an unbearable temperature, the great oil tanks casting a black silhouette across the sky line, impress upon us with no uncertain emphasis the gigantic forces at work in operating the industries of a busy, growing country.

Upon the roof whence the net work of wires depart on their journey to the city, the apparent contrast between the nearby fragile but latest improved type of lightning protectors and the massive concrete chimneys in the background is very striking.



The Redondo Plant.

No detail seems to have been overlooked for complete and economic operation. Even the little automatic measuring box perched upon the feed-water reservoir, is noted as doing its share to complete the picture. As it swings back and forth it not only measures but purifies the entering feed water.

In descending from the roof we note the long gallery containing the switching apparatus, perfectly complete in its isolation and secure in its fire-proof protection. The operating room below, with its switchboards bedecked with signal lights, impresses us with the idea of ease and simplicity in operation.

Immediately upon entering the space set aside for the huge boilers, we encounter the heated flush of out-going air, which is suggestive of temperatures pictured in Dante's Inferno. But upon closer inspection, we find that the scientifically operated oil burners are efficiently transferring the latent heat energies in the oil fluid to the powerful steam-forming drums above.

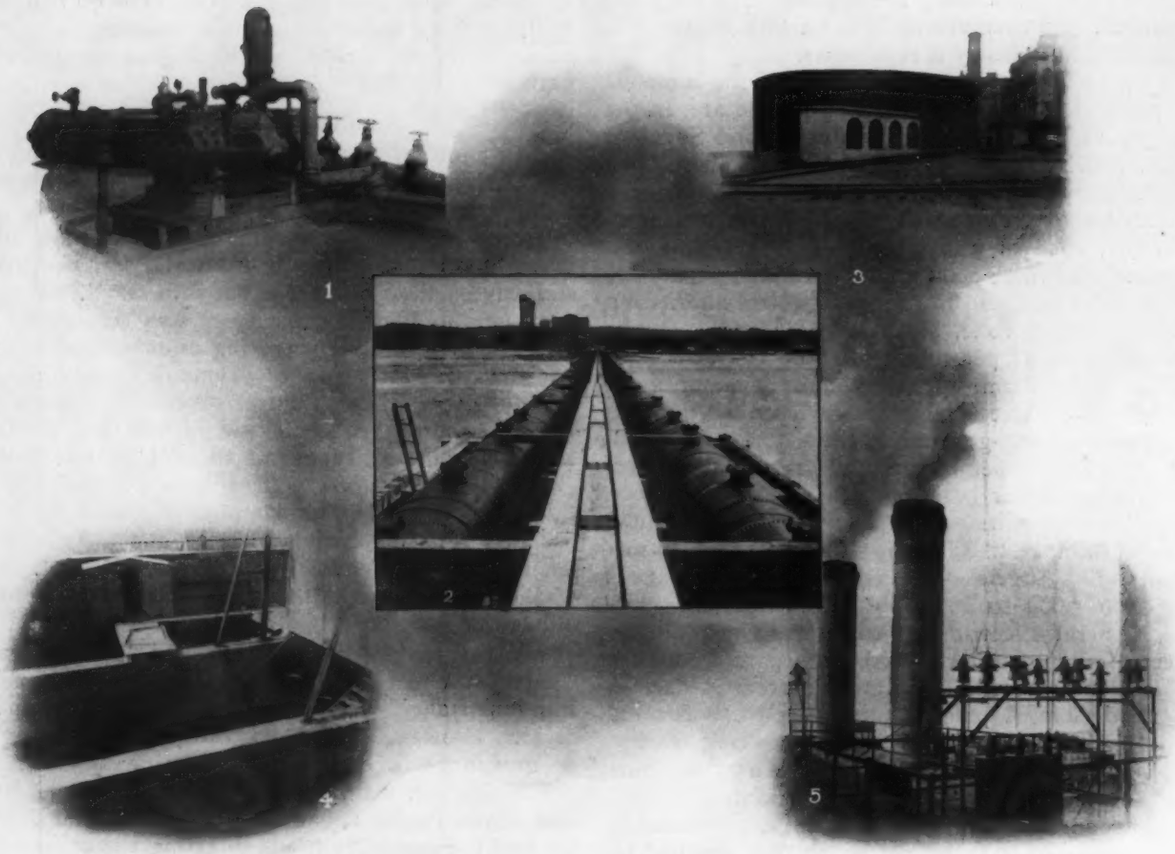
Three huge reciprocating steam units, observed in entering the main power room, are seen grinding out with remarkable steam economy a load of 15,000 kilowatts, while on the west, their two smaller but more powerful neighbors are spinning out on their vertical axes 30,000 kilowatts of electrical energy. A massive crane is observed to travel back and forth at the fancy of a small speck in one corner of its frame-work. Upon closer examination the speck is seen to be a human being, at first unrecognizable because he appears so small in comparison with the rest of the structure.

In going below we are reminded by the condensing apparatus, with their thermometers placed at proper points along the line for accurate steam economy records, that the steam which has so recently been used to drive the gigantic machinery above, is now once again forced to betake itself into the same boilers to be again used at the will and pleasure of man.

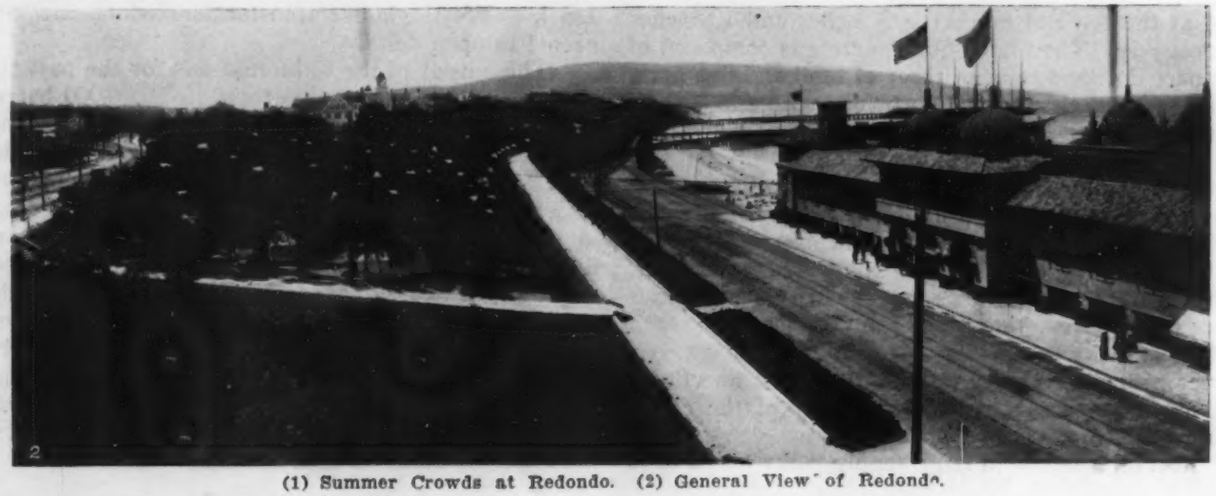
The reciprocating engines found driving three 5000-kilowatt generators were purchased on a guarantee that 170 kilowatt hours be generated per barrel of oil, each barrel weighing 334 lbs. and each lb. containing 18,500 B.t.u. One B.t.u. is that amount of heat required to raise one pound of water one degree in temperature. After an impartial test covering fifteen days, it was found by the group of experts in charge that as a matter of fact 252.8 kilowatt hours were generated per barrel of oil, thus showing one of the most remarkable tests of economic operation on record.

Many pages could easily be devoted to describing the special features made use of in perfecting the efficient operation of this plant. By peering into the intake of the long pipes used in supplying the condensing water, new and improved ideas are seen at once in handling seaweed. By still further following up the circulating water passing through these pipes, new ideas in valve operation and discharge are quickly discerned. The switchboard panels and the wiring leading to it, all possess features of improved and economic installation.

Measuring and Purifying Tank.



(1) Pumping Connections. (2) Intake of Circulating Water. (3) Mammoth Oil Tanks. (4) Grizzles for Sea-Weed Protection. (5) Electrolytic Lightning Arresters.



(1) Summer Crowds at Redondo. (2) General View of Redondo.

The building, housing the apparatus, is solid and substantial. Its concrete walls are a fitting tribute to the substantial industry it represents.

To go more into detail in describing the complete equipment of this plant, we find that there are, in the main generating room, three McIntosh and Seymour engines which drive three 5000 kilo-volt-ampere General Electric generators. There are also, as has been mentioned above, two Curtis General Electric turbo-generators, each of a capacity of 15,000 kilo-volt-amperes. The three 5000 kilo-volt-ampere generators have 60 poles each and furnish three-phase alternating current at 18,000 volts, 50 cycles. These are driven at 100 revolutions per minute by the three vertical, compound, side-crank McIntosh and Seymour automatic, gridiron valve engines above described.

The two turbo-generators alluded to are driven at 750 revolutions per minute and are of the vertical type with condenser base and generate current at 50 cycles and 9000 volts. Since the reciprocating units deliver current at 18,000 volts—the voltage of transmission to Los Angeles—the turbo-generator voltage is raised from 9000 to 18,000 by means of six single phase, General Electric compensators which are Y-connected, oil and water cooled. A separate compensator is also provided. Excitation current is derived from a 100 kw., 4 pole General Electric horizontal turbine exciter, the normal excitation being 60 kw. at 250 volts. The speed of 2400 revolutions per minute is that at which this unit is driven. The unit is operated non-condensing. The step bearings, necessitating an oil pressure of 1000 lbs. per sq. in., are supplied by three steam driven horizontal duplex pumps which are designed to amply take care of the enormous pressures here met.

Superheated steam, which is found of most economic use in the modern turbine, is supplied by 601.9 h.p. Stirling water tube boilers. These are of type 0-24 and are arranged in four batteries of two each. Fuel oil is the source of heat supply.

The make-up water for the plant is supplied by wells on the property and is purified and preheated by two 10,000 h.p. Cochrane vertical feed water heaters and purifiers, right and left connected.

Three reinforced concrete chimneys, which are shown in the illustration, are of massive design. Their height above the boiler room floor is 125 ft., the depth below the boiler room floor being six ft. The inside diameter of the top is 13 ft. and the thickness of the wall at the top and bottom is 7 inches and 10 inches respectively. The foundation concrete is composed of one part Portland cement, three of sand and five parts stone. All the chimneys are provided with two 30-inch clean-out doors.

The most novel and interesting feature of this plant is the system of condensation whereby vacuum is obtained upon which the efficient operation of the turbine is so dependent. The condensers are of the surface type, the steam being condensed by coming in contact with metal tubes through which cold water is constantly circulating. The main condenser for each turbine is in its base. There is also an auxiliary condenser with all necessary water and steam connections. Seventeen miles constitute the journey of the circulating water through the condensers.

Fuel oil is stored in large supply tanks which have a storage capacity of 40 to 45 days. The oil is pumped into auxiliary tanks outside the building at one end of the boiler room, each tank having a capacity of 1000 barrels.

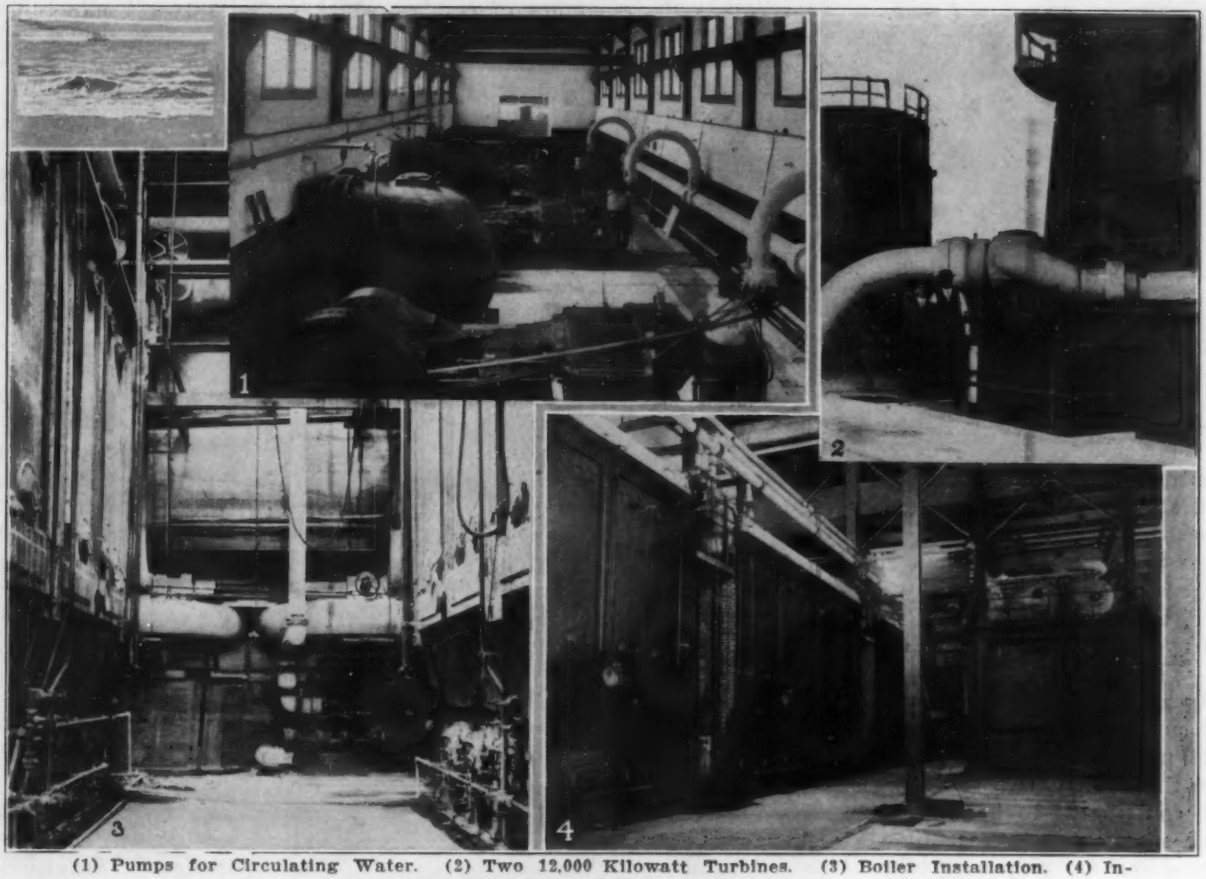
Auxiliary Power Plants.

In addition to the giant installation at Redondo, the Pacific Light & Power Corporation has in operation three other steam plants. The largest of these is that known as the Central Avenue Station and is leased by the corporation from the Pacific Electric Railway. This station was put into service about the year 1902 and has a capacity of 8550 kilowatts. The prime movers are reciprocating units of the Alberger and also the McIntosh & Seymour cross compound engine type. The Central Avenue Station derives its output of 8550 kw. from two 1500 kw. Stanley induction type and three 1500 kw. Bullock generators. One 550 volt, 1050 kw. direct current Westinghouse generator supplies all needs for direct current. The building is of brick and is 140 x 200 ft. There are here installed also, three 500 kw. Stanley transformers for each of the 1500 kw. generators above alluded to.

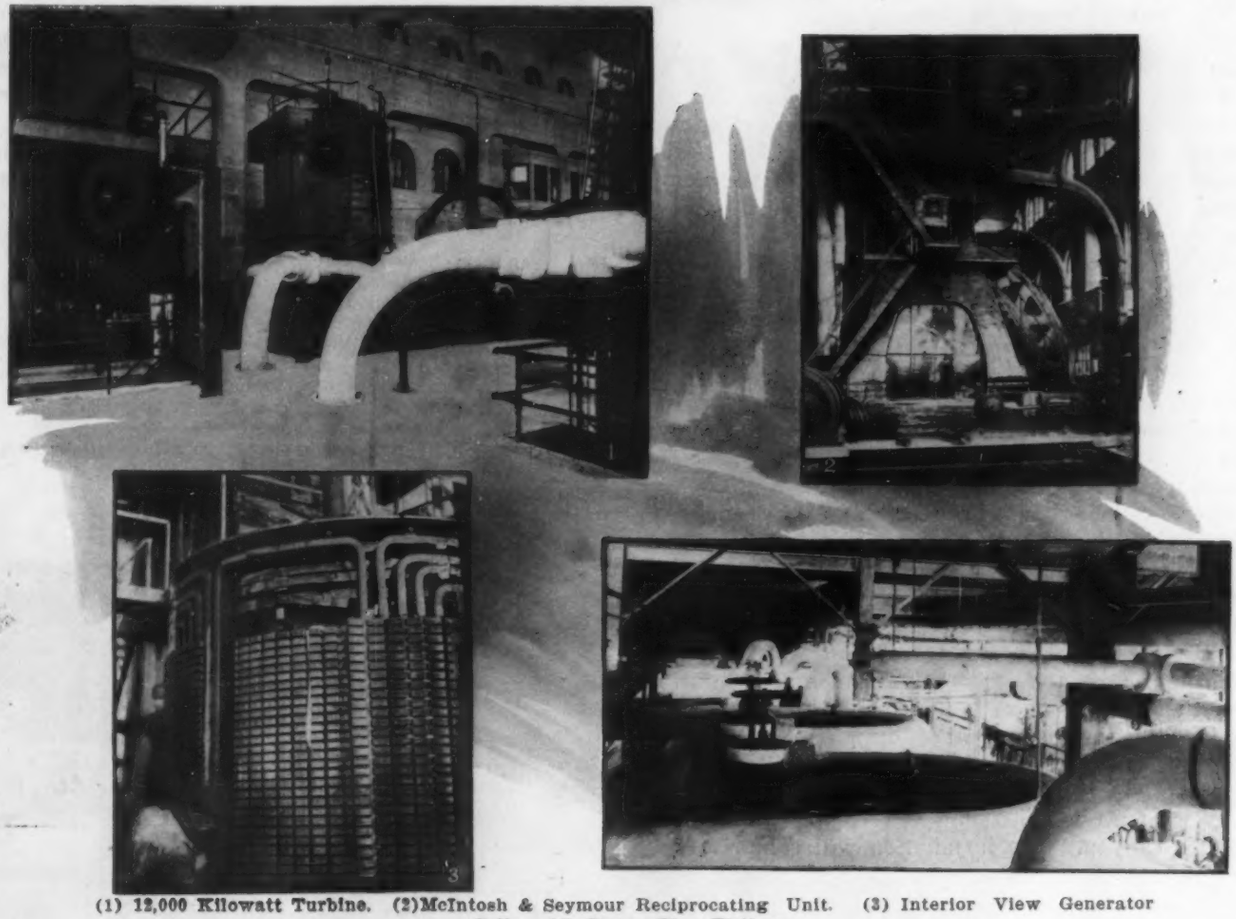
While not so large in installed capacity as the Central Avenue, the Third Street Station far exceeds it in importance. This station has an installed capacity of 2550 kilowatts. As a generating unit it fades into insignificance in comparison with its importance as the life-giving, main artery for the complete installation of the Pacific Light & Power Corporation. Here we find the executive heads directing the operation of both the steam and hydroelectric units. From the Third Street Station emanates the orders which bind the complete hydroelectric and steam development into one pulsating electrical force. In 1898 the Third Street Station was put into efficient operation. The 2550 kw. capacity of this plant consists of one 1500 kw., one 750 kw. and one 300 kw. generator delivering current at 2400 volts, 50 cycles per second. There are no transformers utilized as the buses are fed directly with the 2400 volt current. The building is a substantial brick structure 85 x 125 ft.

The 150 kw. generator is of the General Electric design and delivers current at 2200 volts, 50 cycles per second. The building is of corrugated iron as shown in the illustration and is 50 x 60 ft. A compound Ball engine direct connected with the generating apparatus is the prime mover. Also installed here are two 125 kw. Westinghouse transformers which are connected in open delta.

The output of the California oils for the past season exceeded the enormous total of 78,000,000 barrels and yet in spite of this, electrically operated oil pumps are each day coming into favor and meeting with the popularity of the oil-field management. An opening for electrically operated oil wells has just been made in the Los Angeles installation although at Bakersfield, 150 miles to the north, the old system of oil drilling is rapidly disappearing. Convinced of this growing field of power consumption, the management of the Pacific Light & Power Corporation made a beginning during October of the past year in the meeting of this new need. An installation of 150 kilowatt capacity was made during this month in the midst of the oil wells at Los Angeles.



(1) Pumps for Circulating Water. (2) Two 12,000 Kilowatt Turbines. (3) Boiler Installation. (4) Interior View of Boiler Room.



(1) 12,000 Kilowatt Turbine. (2)McIntosh & Seymour Reciprocating Unit. (3) Interior View Generator Coils. (4) Steam Pipe Fittings.

Azusa.

Operating Room—Azusa.

THE Azusa plant commands a surprising view of the surrounding country. Immediately to the south are thousands of acres of fertile lands nourished by the encouragement from power enterprises of this sort. One mile to the south are the electric railway lines which hurry into the great city of Los Angeles within an hour's time.

The waters used to develop electrical energy in this installation are taken from San Gabriel Canyon and are conveyed through a canal some six miles in length. The intake consists of a reinforced concrete diversion dam of sufficient height to force all the waters of the creek into the canal up to its full capacity. Iron grizzlies protect the canal from incoming driftwood and other rubbish.

The water finally passes through a tunnel 1/3 mile long and emerges at the forebay whence it passes to the power house 404 feet below, through a 38-inch steel pipe. Where the water enters the forebay, two spillways are constructed to handle the excess water or in case of a shut-down to carry away the full head.

Bird's-eye View of Azusa Plant.

The power house is constructed of reinforced concrete with corrugated iron roofing and contains five 300 kw. 50 cycle, two-phase, 500 volt Westinghouse generators, running at 430 revolutions per minute. These are direct connected to four double Doble water wheel units, and one unit of the Pelton pattern. The wheels have two disks per unit. Two of the units are governed by the Lombard type F governor while the others are hand controlled. Belt driven from the generators are four 7½ kw., direct current, multipolar, 125 volt Westinghouse generators which are used as exciters.

The transformer room, above which is the bus gallery, is situated on the up-hill side of the building and extends its entire length. Here are installed eight 200 kw., oil insulated, water cooled, 50 cycle step-up Westinghouse transformers. By means of the Scott connection the voltage is raised from 500 two-phase, to 17,500 volts three-phase.

Ever eager in their efforts to improve obsolete or inefficient apparatus, the company is installing aluminum electrolytic cells for lightning arresters, thereby replacing the present spark gap installation. This improvement is also being undertaken in all of the other plants owned by the company and not as yet equipped with this improved design.

Not satisfied with utilization of the six miles of San Gabriel Canyon waters as just described, the company is at present installing a second plant 17 miles up this canyon. The installation will comprise 10½ miles of conduit which includes two 4-mile tunnels. The tunnels are to be 7 x 3 feet concreted throughout. The waters of San Gabriel Canyon, after being conducted through this 10½ miles of canal, will arrive at the forebay from which they will be taken almost precipitously 1000 ft. downward into the power house below, where a plant of 6000 kilowatt capacity will utilize their enormous kinetic energies.

When we see a completed hydroelectric plant before us resplendent in the beauty of the noon-day sun we are not always able to properly picture the engineering skill and planning it has necessitated. No small item among these features is that of transporting over a rough and precipitous country, the heavy machinery required in the installation. This new undertaking in San Gabriel Canyon is no exception to the rule and now, during its days of construction the picturesque sight of the pack train and the freighter can be seen wending their way up the narrow defile. Transportation, like the other apparently unsurmontable obstacles met with in engineering practice, are, however, but mere child's play in the hands of the constructive engineer. They serve, nevertheless, as monuments of accomplishment in hydroelectric development in the West.

Like the waters of Santa Ana River, those of the San Gabriel will perform the task of grinding out energy for the burdens of man over and over again, as they descend toward the valley below. This is a striking feature of the hydroelectric development in Southern California where water plays the important role. Although they are eventually to be used in irrigation, first they are harnessed to give up their latent energies for man's use.

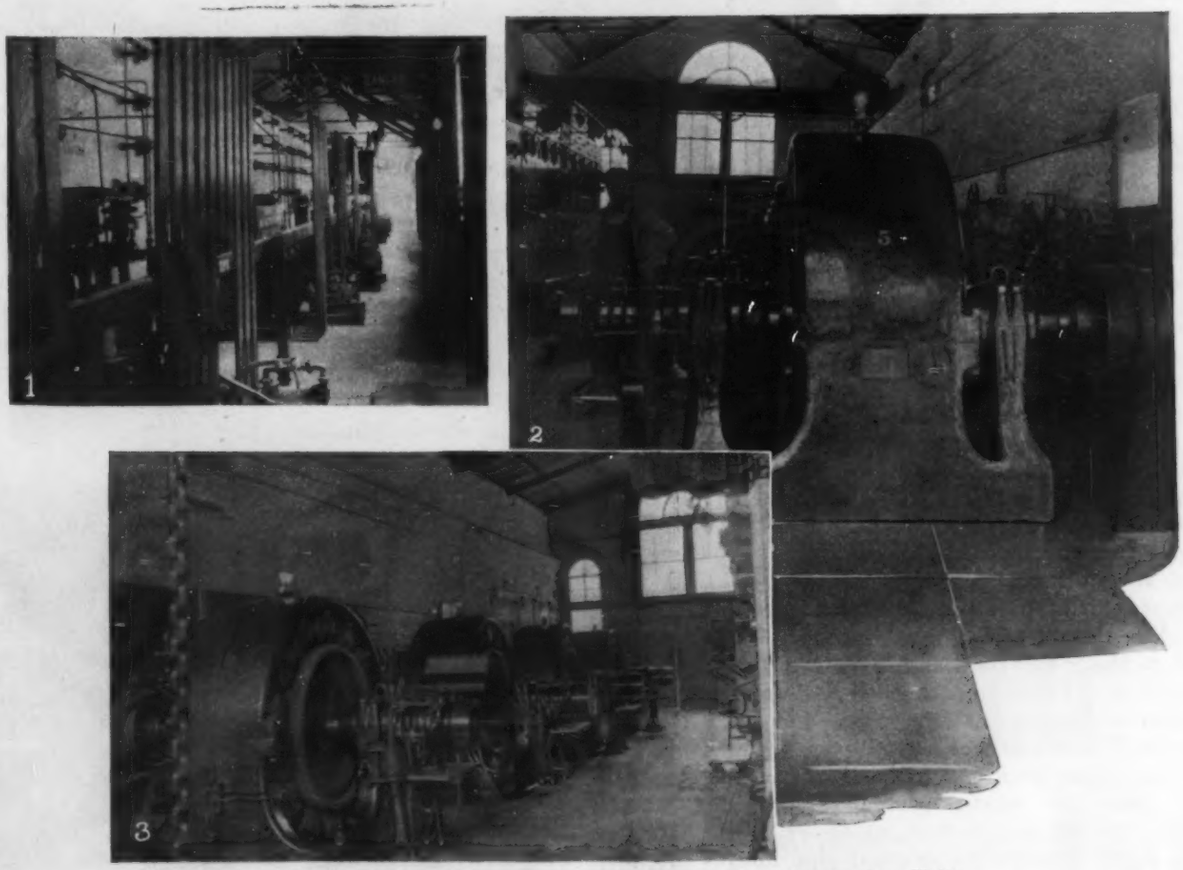
It is interesting to examine a summary of the main features in this plant. This is found in the following:

Physical Data for Azusa.

Length of main ditch and flume system, 6 miles.
Flow per second in main ditch system, 80 sec. ft.
Elevation of head (total drop), 401 ft.
Number of impulse wheels, 4 Doble and 1 Pelton.
Total electrical h.p., 1500 kw., 5-300.
Generator voltage, 500 volts.
Altitude of forebay or reservoir, 1250 ft.
Altitude of power house, 850 ft.
Exterior dimensions of power house, 47 ft. x 72 ft.
Material of building, concrete on concrete foundations, with steel truss and corrugated roof.
Date of placing plant in service, June 30, 1898.

Spillway, San Gabriel Canal.

(1) Forebay. (2) General View plant and Pen-Stocks. (3) Intake Azusa Canal.



(1) High Tension Room. (2) Operating Room. (3) Azusa Generating Units.

SIERRA AND STONE CASTLE PLANTS.

Tailrace, Sierra.

THE beginning of the installation known as the Sierra Plant was a history maker for hydro-electric development. In 1892 awe-inspired visitors were informed that the little concrete building housed the longest distance transmission power plant in the world. The delapidated structure shown in the illustration is the silent reminder of this historical event.

Mt. San Antonio, locally known as "Old Baldy," forms the major portion of the watershed for nearly all the streams supplying the so-called citrus belt in Southern California. San Antonio Canyon, through which flows the creek of the same name, is situated to the north, and midway between Ontario and Pomona, two of the most enterprising orange producing sections of the State. The canyon is picturesque; about six miles from its mouth a stone barrier several hundred feet in height, commonly known as the "Hog's Back," completely checks the waters of San Antonio Creek in their mad rush to the fertile valley below. As if, however, crazed with frenzy at being thus thwarted in its peaceful journey, the stream, as shown in the illustration, leaps over a series of waterfalls through a depression in this Hog's Back.

Stone Castle Plant.

Engineers, early in the '90s, conceived the idea of diverting the water of this creek immediately above the waterfalls and taking it by means of a tunnel through the Hog's Back, thence by pipe line down to the old Sierra plant. Ideas were crude in those pioneer days, and the old switchboard, shown in the illustration, bears record of the fact that the first high tension transmission plant in the world conveyed energy at 10,500 volts, generated this electric power at 1,000 volts, which was stepped down to 500 volts, and then by means of twenty-one of the secondaries of these transformers connected in series, 10,500 volts were obtained for transmission.

But this is of historical interest. Let us pass now to the present status of this complete power installation. The waters are diverted as formerly, but instead of the crude flume diversion works, there is now built a substantial concrete and rubble masonry diversion dam from which the steel riveted pen-stock pipe takes its water, passes through the tunnel above referred to and then, as shown in the illustration, down through the original pipe line to the new power plant.

The Sierra plant consists of two 54-inch 400 h.p. single Pelton water wheel units which are governed by a type F Lombard governor. The riveted steel pipe line running directly to the power house from the intake above the Hog's Back, has three varying diameters, namely 30, 26 and 22 inches. The pipe line is substantially installed and is in excellent shape at the present time. The water wheels which are located immediately without the building are installed on concrete foundations and deliver water through the cement lined tail-race as shown in illustration.

Directly connected to these two water wheel units are two 300 kw. Westinghouse generators operating at 430 revolutions per minute. The exciters, two in number, are belt driven and are of the Westinghouse, 5-polar, 7½ kw. direct current, 125 volt type.

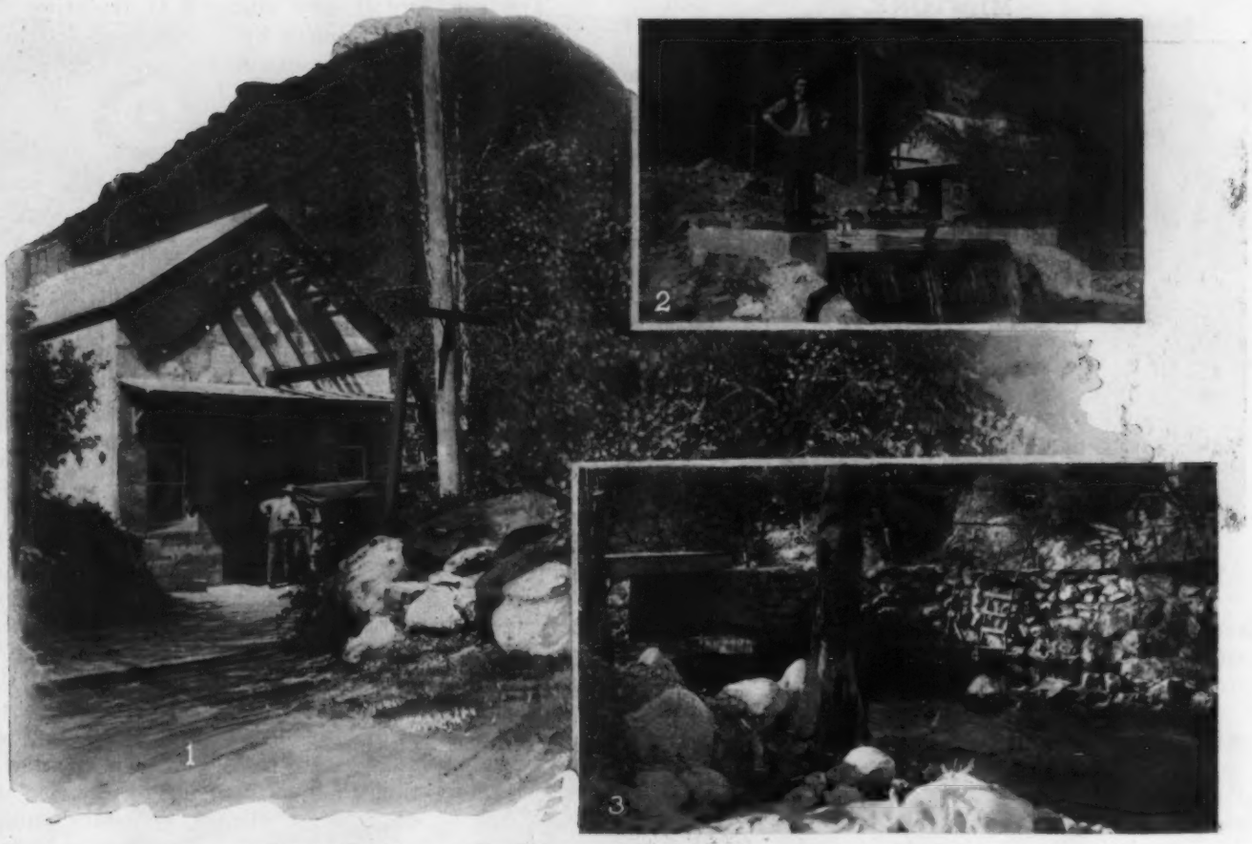
The transformers in the main operating room are in two banks, one containing two 200 kw., oil insulated, water cooled, 50 cycle, 500 volt two-phase step-up Westinghouse transformers raising the voltage to 17,500, three-phase Scott connection. The other bank is of similar detail but consists of two 250 kw. transformers instead of the 200 kw. capacity.

The Stone Castle plant utilizes about 200 miners' inches of water hitherto passing by subterranean channels to the sea. This water is conducted around the east side of the entrance to San Antonio Canyon, and finally by means of a steel pipe, it is passed through nozzles, develops 65 kilowatts and is then used to quench the thirst of former desert lands now supplied by the Ontario Water Company, who developed this supply by diverting it from subterranean sources.

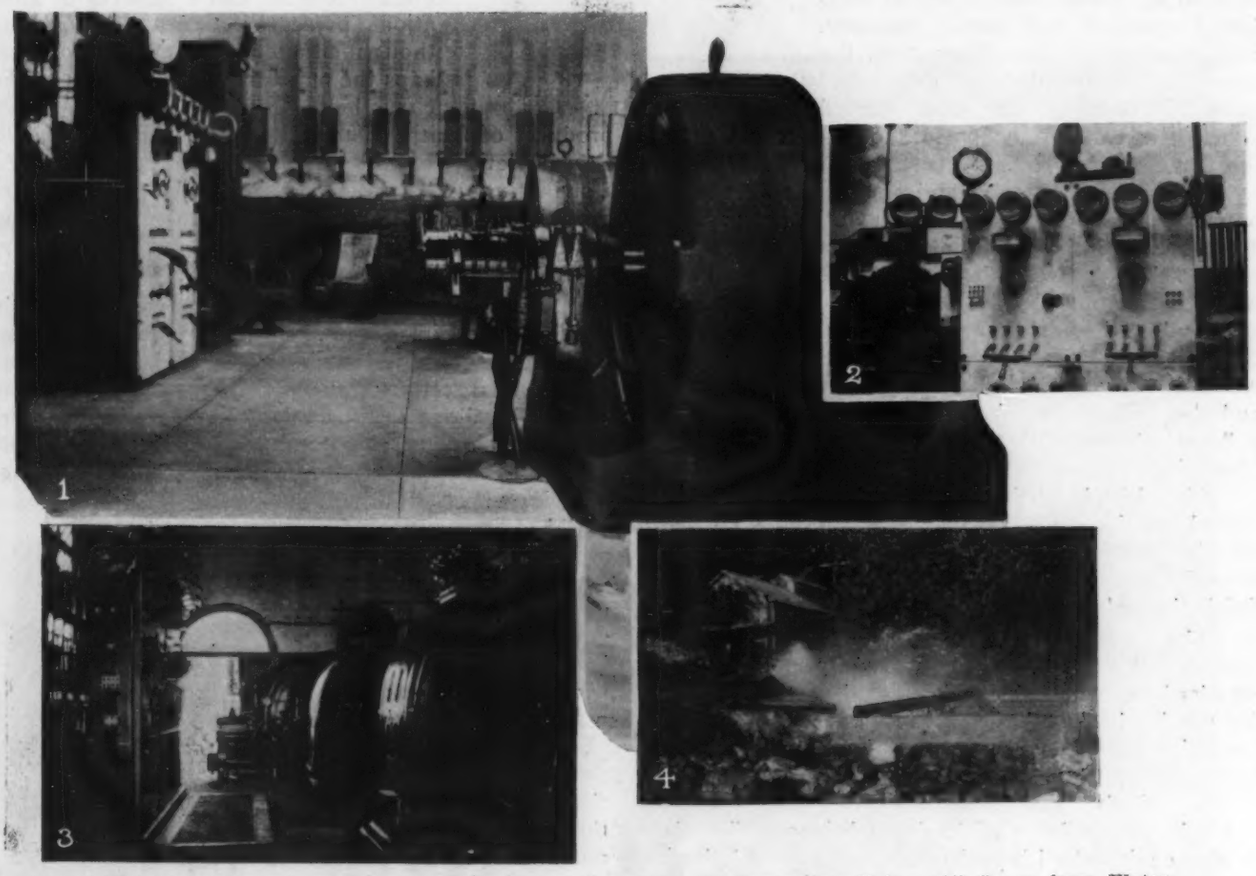
This station is not connected in parallel with the main generating net-work. At the power house, nevertheless, may be found switching apparatus from which the main circuit distribution can be regulated.

The power developed in this installation is used mainly to operate some twelve to fourteen miles of electric railroad owned by the Pacific Light & Power Corporation. This plant is situated at the head of several miles of incline. Formerly this seven and one-half miles of steady rise were operated by means of mules, which pulled the car to the head of Euclid avenue. There the mules were placed on an attachment in the rear of the car, and the car, with its livestock attachment, was then rolled down by gravity the entire distance.

Waterfalls at Hog's Back.

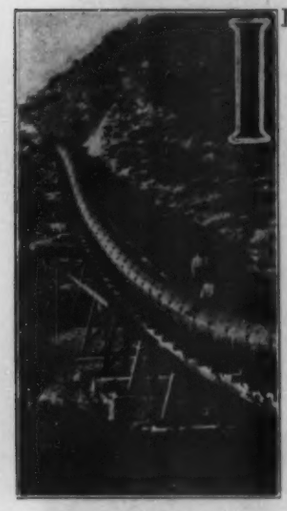


(1) Power Plant House. (2) Weir Foot of Tail Race. (3) Concrete Intake Sierra Canal.



(1) Interior Operating Room. (2) Switchboard Panel. (3) Generating Units. (4) Spray from Water Wheels.

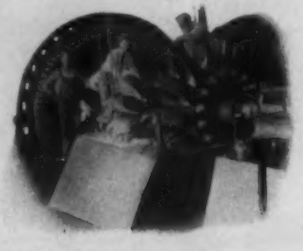
MENTONE.



Woodstave Siphon.

IF the observer follows the waters of the Santa Ana from the time they rise in the snow-capped mountains until they lose themselves in the fertile, irrigated fields below, a most interesting and economic study in power development is at once apparent, for the waters of this river are diverted through concrete lined canals, then through pen-stocks and water wheels, over and over again in their journey to the sea. The waters, however, during many months of the year never reach the Pacific. When they have finally served to their fullest extent the demands of power generation they are completely absorbed in irrigation applications and leave but an "arroyo seco" or "dry river" to mark their pathway to the ocean.

The Mentone power house, three and one-half miles east of Mentone, on the Santa Ana River, is one of the newest of the Pacific Light & Power Company's plants, having been installed in 1904. The intake dam about three miles above the power house, is massive and substantial, being constructed of reinforced concrete and rubble masonry, and, as shown in the illustration, the waters are controlled by substantial gates. When they are once started upon their way to the power house, the capture of the waters is complete.



Water Wheels at Mentone.

Open flumes, tunnels and siphons break the monotony of flow in their merry rush to the power house. The siphon work, consisting of redwood stave pipe, is 60 inches in diameter. The tunnels are eight in number, one being 1400 feet long. At the end of the conduit the waters are turned into the pen-stock 352 feet above the power house. Let the supply of water through the pen-stock be checked for one instant, and the spillway, as shown in the illustration, forms a beautiful waterfall as picturesque as those of the Yosemite.

The altitude of the Mentone power house is 1898 feet above the sea while that of the forebay or reservoir is 2250 feet. The canal is designed to carry 80 second ft. of water and is of thorough workmanlike finish throughout its entire length.

The power house itself is built of reinforced concrete, 50x40 feet with corrugated iron roofing. A standard twenty-ton crane is erected on the side walls for use in the installation of machinery. There is in operation one 1500 kilowatt revolving field Westinghouse generator. A carefully balanced governor is master of the situation, controlling any tendency towards unsteadiness of load conditions. The plant is also equipped with exciters, transformers, lightning arresters and other necessary accessories.

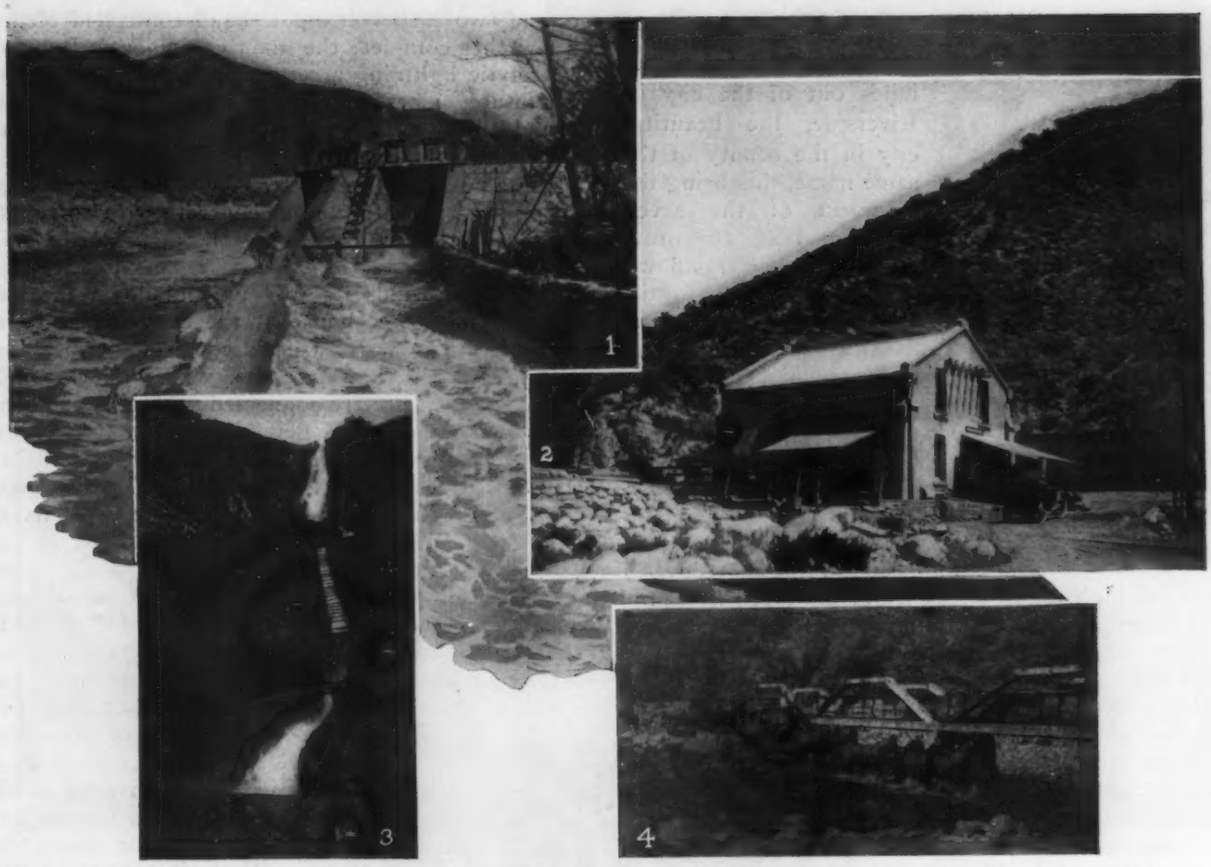
The company is now engaged in replacing the older type of transformers by 3 improved 750 kilowatt General Electric transformers, thus again illustrating the company's zeal in keeping up with the march of progress in affairs electrical.

As we gaze out into the arid but fertile valley stretching forth from Santa Ana Canyon, the possibilities of this district cannot help but deeply impress us. Water is the only crying need and when once applied the arid valley certainly shows its deep appreciation. An interesting water development has taken place almost immediately below the Mentone power plant. During the flood period when thousands of acre feet of water would ordinarily rush madly to the sea, these waters are not only corralled in the big reservoir dams above but even the surplus is flooded over the arid lands at the mouth of the canyon. It has been found that the water so flooded stores itself for a period beneath the surface and a few miles down the valley during the dry season, by means of electrically operated pumps, it is found once again subservient to the use of man. This demonstration during the past season has convinced practical men of the availability of this method of water development. Once again we see that this process of developing water and thus making the arid lands blossom is resulting and will continue to result in the utilization of thousands of kilowatts of electrical energy to operate the necessary pumps.

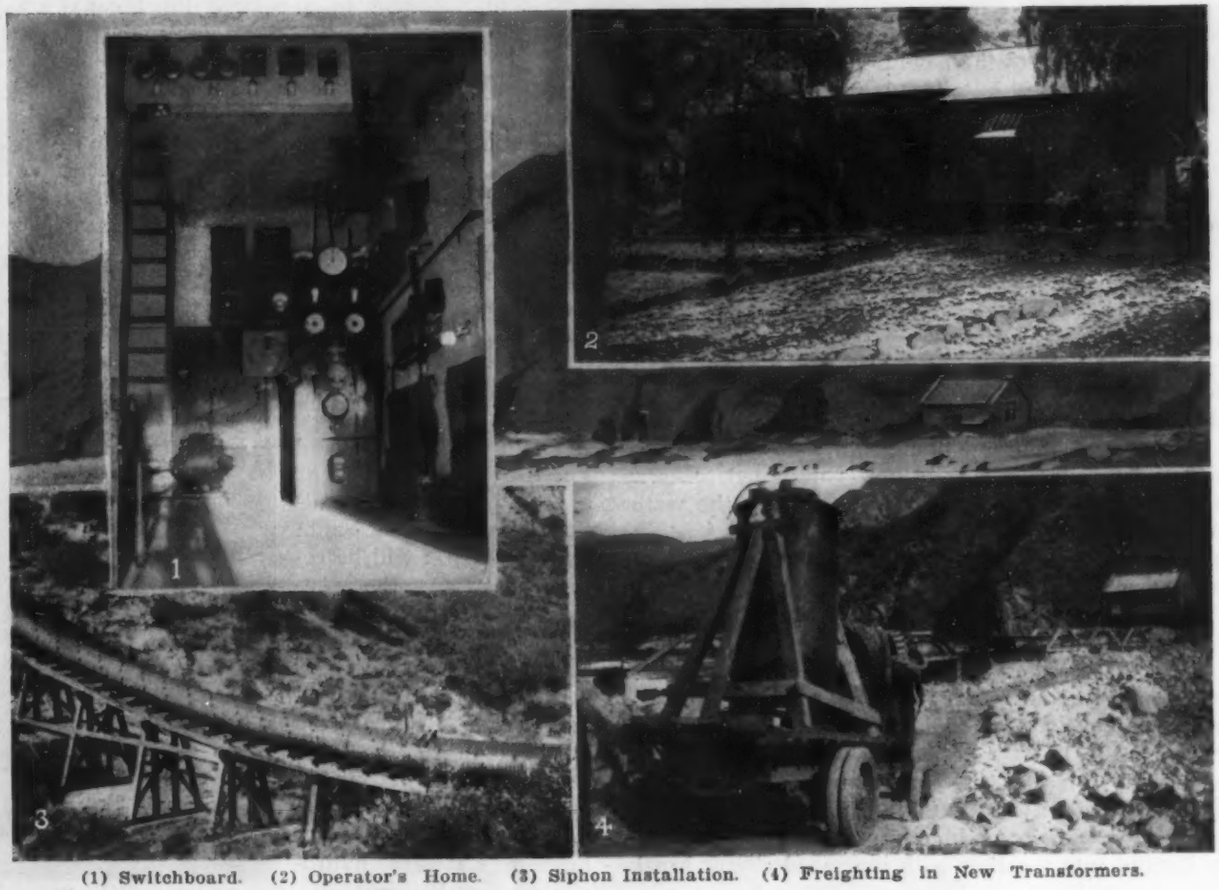
The Mentone power plant is located some seven miles from San Bernardino. Here we find a remarkable situation presented. San Bernardino, though situated in the heart of perhaps the most productive section of the citrus belt, is yet not in itself a heavy producer of fruits. Due to its unusual railway facilities, however, it is rapidly becoming the center of a distributing net-work which augurs well for future growth, both as to a distributing and manufacturing center. The field then for future power consumption in this locality is of unusual promise.

San Bernardino County is the largest county in the State, and in fact in the nation, its area comprising 20,160 square miles. The city of San Bernardino owns the largest artesian well in the country, flowing 3,000,000 gallons every 24 hours. More, longer and heavier trains carrying fresh fruit are made up and sent out of San Bernardino than out of any other shipping port in the world. The cultivable area of this county supports more persons per square mile than any other rural district in the country. Three transcontinental railroads: the Atchison, Topeka & Santa Fe, the Southern Pacific, and the Salt Lake pass through this metropolis, and their shops keep thousands busy.

"Stage" at Mentone.

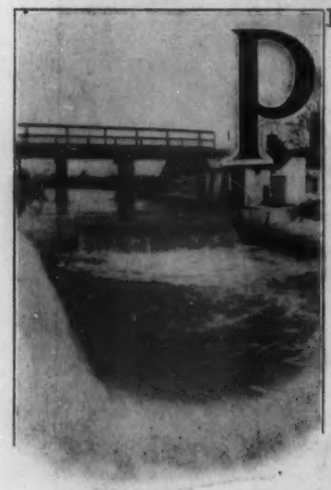


(1) Reinforced Concrete Intake. (2) Power House. (3) Spill Way. (4) Santa Ana River Near Power House.



(1) Switchboard. (2) Operator's Home. (3) Siphon Installation. (4) Freighting in New Transformers.

PEDLEY AND HIGHGROVE.



Canal for Pedley Station.

PEDLEY is situated a few miles out of the city of Riverside, the beautiful city in the county of the same name, this being the youngest of the seven counties that constitute what is properly known as Southern California. Riverside County has over 7,000 square miles of territory and a population of about 25,000, and its assessed valuation speaks to the extent of $18,000,000. Three transcontinental railroads annually groan under the burden of 6,000 car loads—2,304,000 boxes—of high grade citrus fruits produced herein.

Picturesque Riverside County has within its border 130 miles of irrigating canals which cost over $4,325,000. Thousands of acres in addition but await proper facilities in the way of more electrical power to pump water in order to make them blossom as the rose. An annual income of nearly $9,500,000 from this county is a sufficient guarantee that its boasted agricultural possibility is no mere joke.

Operating Room—Pedley.

The handsome concrete bridge structure shown in the illustration is that of the newly constructed Salt Lake Railroad passing over the Santa Ana near the intake of the canal which feeds the Pedley power plant. In fact a careful observation of this picture will discover in outline the canal and headworks just alluded to. The canal is six miles from the intake to the forebay, just above the power house and shown in the illustration. It is a small concrete structure situated on the hillside eighty-seven feet above the power house. Grizzlies protect the entrance to the pen-stock, and the spillway, which can be seen in the photograph, conveys the excess water to the river below the power house.

The main ditch and flume system for the Pedley plant is six miles in length and is designed to carry 100 second ft, of water. The total drop of the water from the forebay to the power house is 86 ft. The altitude of the power house above the sea is 514 ft., consequently that of the forebay is 680 ft.

The exciters used in this plant are General Electric type machines generating 136 amperes at 125 volts. These operate either by separate water wheels or by induction motor so arranged that it can propel either one of the exciters. Stanley transformers, stepping from 10,500 to 17,500 volts enable this plant to operate in parallel with the other installations of the Pacific Light and Power Corporation.

The five panel switchboard provided with all modern instruments together with improved circuit breakers and two 1500 volt 3-pole hand controlled Kelman oil switches complete the main equipment. Improved electrolytic lightning arresters will be installed in the near future. These arresters are being installed on the ground adjoining the transformer gallery to the east of the power house.

The power house is 60x30 feet, and is of the latest design, being constructed of concrete with corrugated iron roofing. The two side walls of the main building are re-inforced to support a twenty-ton traveling crane, which winds its way up and down the main room of the power house at the convenience of the operator. The water wheels consist of two 22-inch high pressure Victor turbines, which develop 1,000 horsepower. Directly connected with the main units are two 300 killowatt General Electric 50 cycle, three-phase generators. A Lombard governor, exciters, and all the other accessories that go to making the complete power plant, may be found in the installation.

Highgrove.

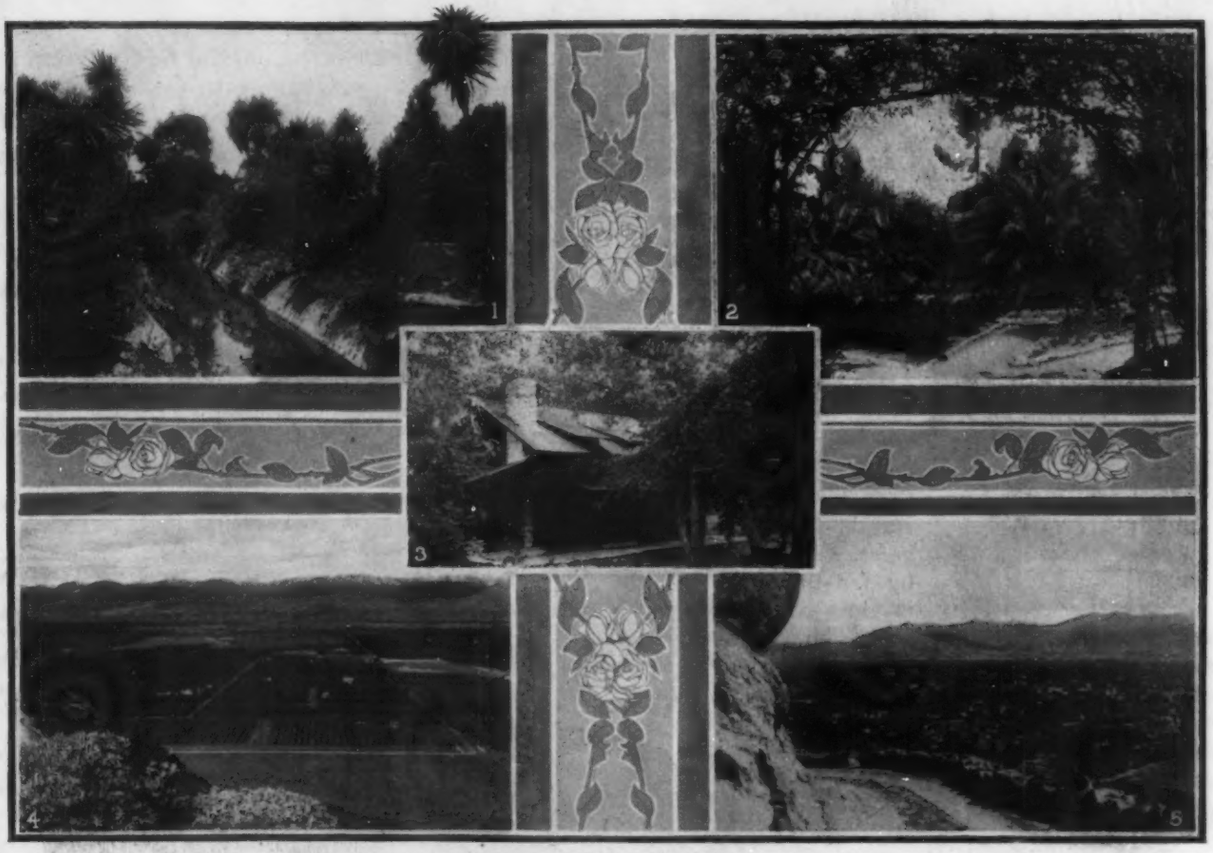
The Highgrove power house is ½ mile northwest of Highgrove, a suburb of Riverside. The intake of the canal is four miles above the power house, one mile east of Colton. A small concrete dam has been thrown across Warren Creek, one of the tributaries of the Santa Ana River. Fifty second ft. of water is then conveyed southward by means of a cement lined canal as far as the Santa Ana River. There it connects with a wooden flume which carries the water over the Santa Ana Wash to a cement lined canal on the other side, which extends southwesterly along the mesa to the small forebay 50 ft. above the power house.

In the power house is installed two 16-inch Stillwell-Bierce turbines, which operate under a 40-foot head. One 150 kilowatt General Electric generator supplies the electrical energy. Suitable transformers, exciters, and other necessary accessories complete the installation.

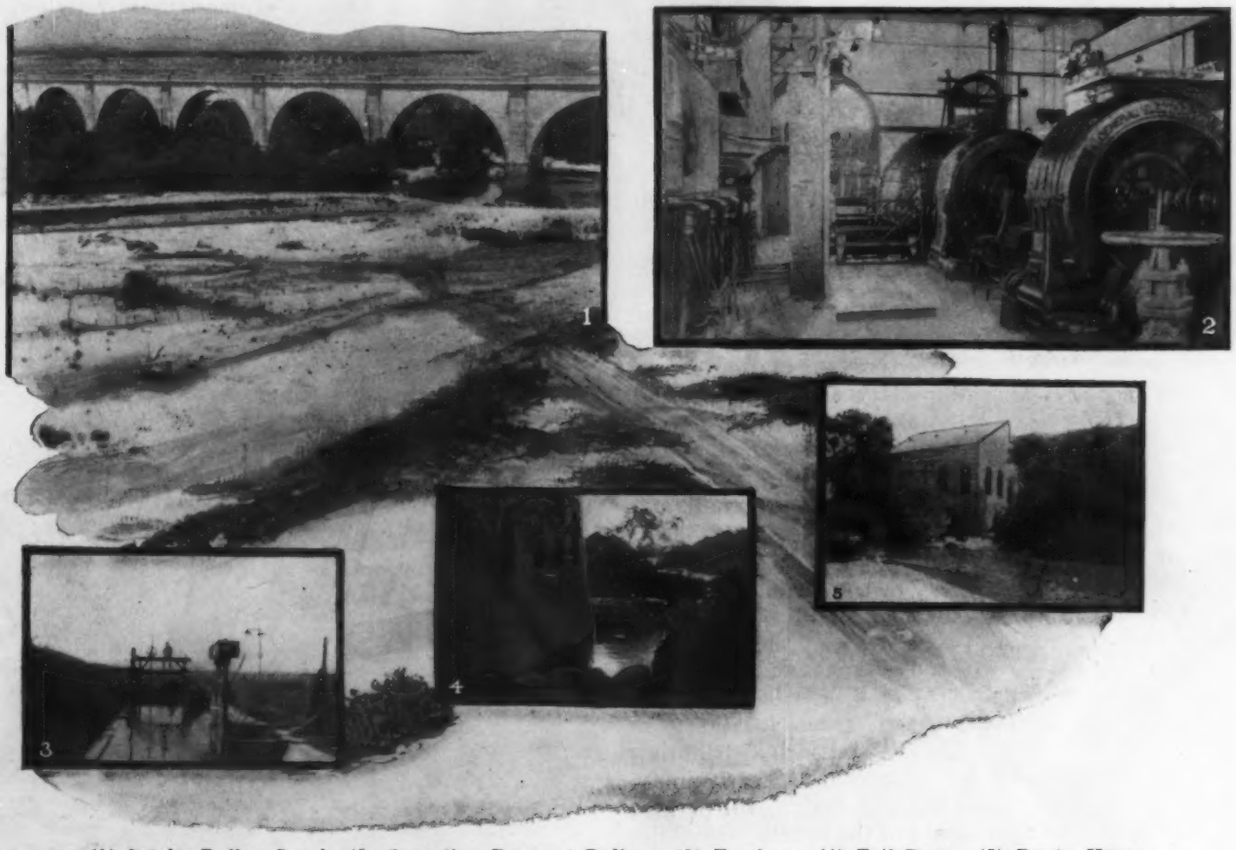
This power plant is unique in that it is located in the heart of the orange tree section and the merry hum of its water wheels seem in thorough synchronism with its happy surroundings.

The Santa Ana River.

The Highgrove and Pedley installations, as has been noted, both utilize the waters of the Santa Ana River. It will be recalled, also, that the Mentone plant is located on the same river. The Southern California Edison have two plants still farther up toward the headwaters. This brief resume of the economic use of the waters of the Santa Ana shows the highest state of hydro-electric development.



(1) Canal at Riverside. (2) Tropical Scene at Redlands. (3) Summer Home of W. G. Kerckhoff.
(4) Summer and Winter Scene Near Riverside. (5) General View of Riverside.



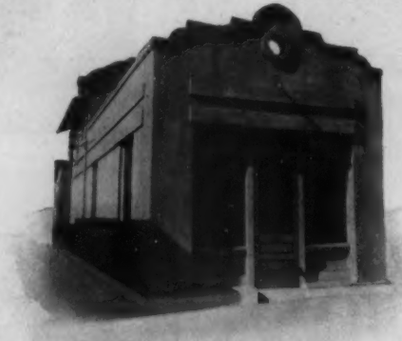
(1) Intake Pedley Canal. (2) Operating Room at Pedley. (3) Forebay. (4) Tail Race. (5) Power House.

Substations.

University Substation.

THE Pacific Light & Power Company is engaged in supplying power to a country teeming in Spanish traditions. It is fitting, then, wherever conditions warrant, that the style of architecture should have a tendency to that of the mission make up.

The electric energy started at the Borel plant under an impressed voltage of 60,000, finally ends its weary journey at the Kern River sub-station in East Los Angeles. The sub-station is by far the most import- is located on Mission Road just east of East Lake Park. The throbbing transformers here installed are within hearing of the busy transportation line of the Pacific Electric Company. This company at frequent intervals sends its passenger-loaded cars humming along the short line between Pasadena and Los Angeles. This is one of the many ways in which it utilizes an enormous supply of electrical energy.



Covina—The Model Substation.

The structure is a modern three-story building constructed of reinforced concrete and fitted with the latest apparatus. In the distance can be seen the double-pole lines of the Borel station as they come over the vanishing point in the horizon. They finally enter by the orderly net-work found upon the third floor of the Kern River sub-station, each in a separate quarter. It is interesting to note the systematic manner in which the 15,000 volt terminals are brought up through their selector switches and thence to their proper buses. This Kern River sub-station might be thought of as the main artery supplying the life fluid to the entire system.

The Covina sub-station is an illustration of the standard design adopted by the company for this branch of installation. It is roomy, fireproof, and affords economic operation.

The University sub-station, situated in the southwest portion of Los Angeles, is an example of the neat and orderly design of some of the larger work of this class.

It is truly said that upon the economic distribution of the substations depend the final distribution of the dividends. The selection of the various locations for substations has been wisely made and each distributing district is located with its substation as nearly in its center as conditions of safety and design will permit.

The neat, trim appearance of the substations of the corporation located along the lines of the Pacific Electric Company add their portion in the gaining of the national reputation for efficiency enjoyed by the remarkable suburban electric lines of Los Angeles.

The tile roofing on the model substation—Covina—is certainly in thorough accord with the Spanish traditions which exert such a powerful influence throughout the whole of Southern California.

Sunnyslope Substation.

Capacity of transformers, 2-250 kw.
Voltage transformation, 15,000 to 2400.
Size of transformer structure, 16 ft. x 24 ft.
Material and description of transformer building, corrugated iron.

Physical Data for Third Street Substation.

Capacity of transformers, 6 625 kw., 4 250 kw., 2 250 kw., and 6 125 kw.

Voltage transformation, 15,000 to 2400 volts, 15,000 to rotary A.C., 15,000 to 5000.

Capacity and size of any rotary converters or motor generators giving types and makes, 1 400 kw., 2 225 kw., 220 v. D.C., 1 250, 1 400, 500-volt D.C. Westinghouse.

Size of transformer structure, 25 ft x 92 ft.

Material and description of transformer building, brick with iron roof.

Kern River Substation.

Capacity of transformers, 12 750 kw., 1 300 kw., 1 625 kw., 2 375 kw.

Voltage transformation, 50,600 to 15,000, 15,000 to 2400, 15,000 to 5000 volts.

Size of transformer structure: 1 room, 7 ft x 73 ft.; 1 room, 20 ft. x 8½ ft.; 3 rooms, 19½ ft. x 8½ ft.

Material and description of transformer structure, concrete with tile roof.

San Bernardino Substation.

Capacity of transformers, 3 250 kw.
Voltage transformation, 15,000 to 2400 v.
Size of transformer structure, 24' x 50'.
Material and description of transformer building, brick with iron roof.

Covina Substation.

Capacity of transformers, 3 37½ kw.
Voltage transformation, 15,000 to 2400 v.
Size of transformer structure, 14' x 47'.
Material and description of transformer building, concrete with tile roof.

South Pasadena Substation.

Capacity of transformers, 2 250 kw.
Voltage transformation, 15,000 to 2400 v.
Size of transformer structure, 14' x 47', with tile roof.
Material and description of transformer building, concrete.

Hollywood Substation.

Capacity of transformers, 3 250 kw.
Voltage transformation, 15,000 to 2400 v.
Size of transformer structure, 14' x 65'.
Material and description of transformer building, concrete with tile roof.

University Substation (arcs only).

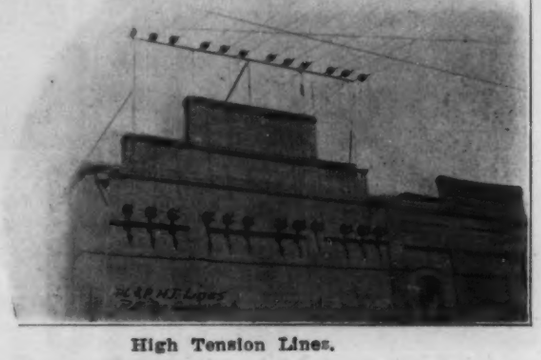
Capacity of transformers, 1 300 kw. and 1 625 kw.
Voltage transformation, 15,000 to 5000 volts.
Size of transformer structure, 33 x 40 ft.
Material and description of transformer building, corrugated iron and brick.

Huntington Park Substation.

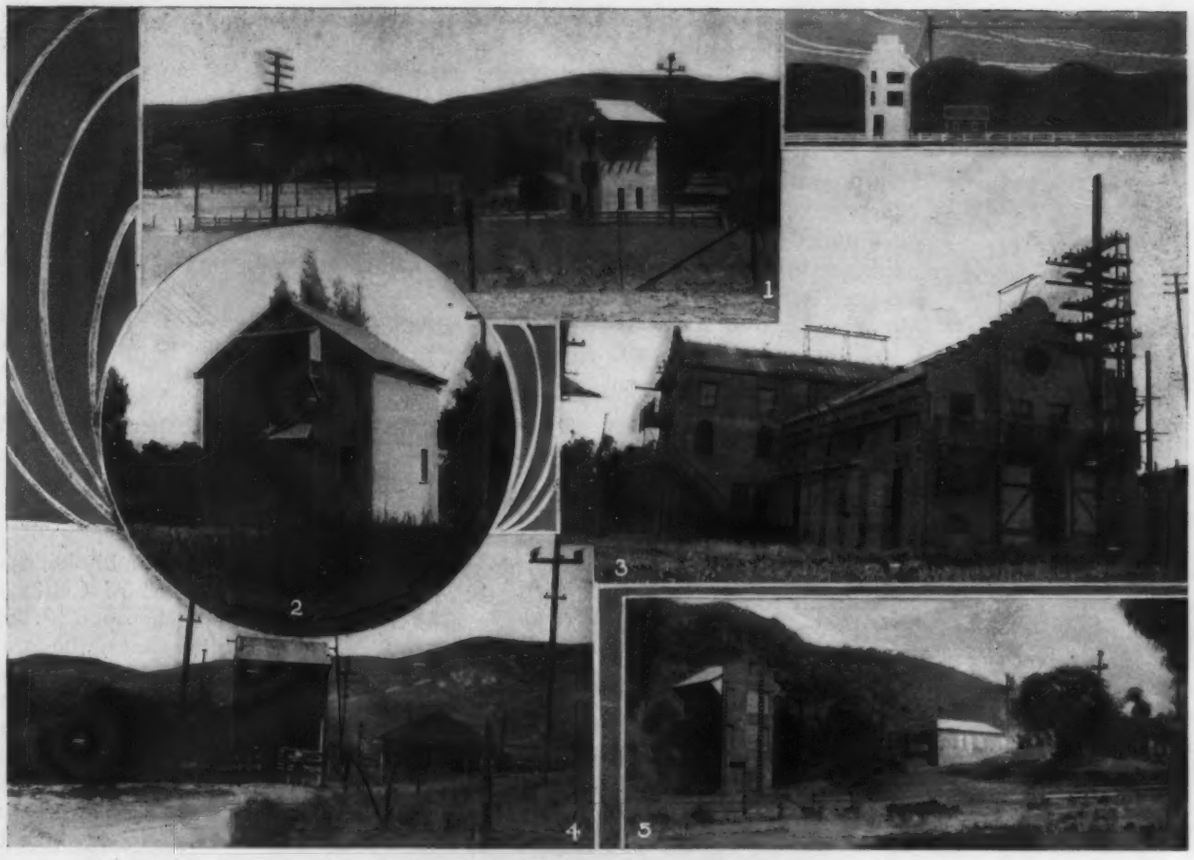
Capacity of transformers, 2 150 kw.
Voltage transformation, 15,000 to 2400 volts.
Size of transformer structure, 18 x 30 ft.
Material and description of transformer building, brick, concrete and corrugated iron.

South Pasadena Substation.

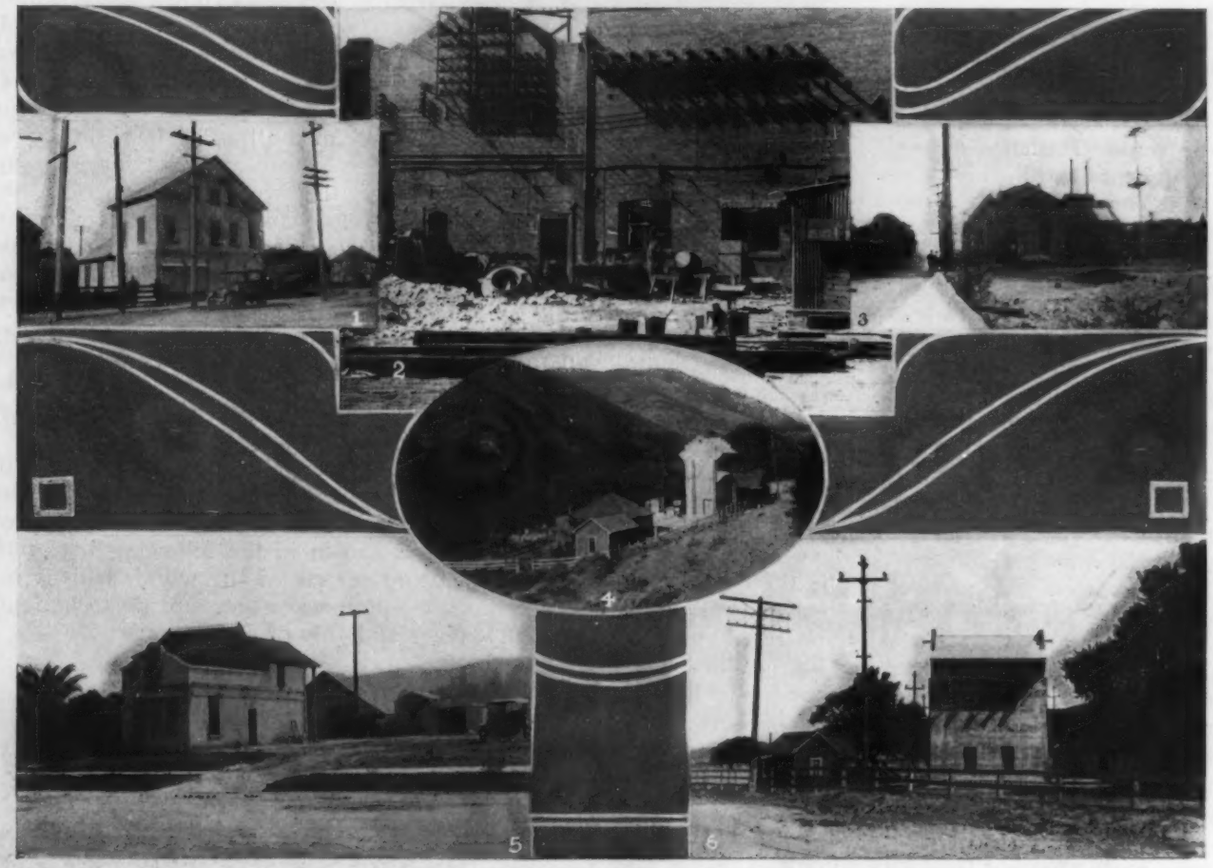
Capacity of transformers, 2 250 kw.
Voltage transformation, 15,000 to 2400 volts.
Size of transformer structure, 14 ft. x 47 ft. with tile roof.
Material and description of transformer building, concrete



High Tension Lines.



(1) Newhall Substation. (2) Sunnyslope Substation. (3) Kern River Substation. (4) Lake Substation. (5) Indian Substation.



(1) University Substation. (2) Third Street Substation. (3) C Street Substation, San Bernardino. (4) Oak Substation. (5) Pasadena Substation. (6) Newhall Substation.

SOUTHERN CALIFORNIA.

St. Catherine's Well.

SOUTHERN California's charms have been painted by artists and sung by poets. It is not the purpose of this article to picture in highly colored paintings the beauties of this section of the Golden State, but rather by a few descriptive words to tell something of human interest to those desiring to know the facts about this much-talked-of section of California.

By a glance at the relief map of Southern California, shown herewith, it is seen first that this section of the state is hemmed in by the ocean on the west, the sun-lit deserts on the east, the mountain barriers on the north and south. Almost every condition of climate can be experienced within a day's ride. At the balmy beaches one can enjoy an ocean plunge in the dead of winter, and yet in the height of summer one may climb up into the high mountains and visit the perennial snows.

This section of the country is above all a livable place, and perhaps this fact, more than anything else, accounts for its remarkable and substantial growth during the last decade, a growth that is unparalleled in the census statistics of the U. S. Census Board.

Typical Scene at Redlands.

The country is for the most part an arid section, requiring the scientific application of water to bring out the best results. For this reason no other place in the world presents such a high state of scientific irrigation as is to be found below the Tehachapi Pass. It is an old adage which reminds us that "time is money." In Southern California above every thing else "water is money." Mountain lakes have been reservoired, dam sites explored, and immense areas flooded. The underground waters of canyons have been tapped and utilized, artesian wells have been sunk, and pumping deep beneath the surface of the earth has been found most profitable. Such highly scientific development, however, is requiring enormous outlays of power. Such power applications comprise the most ideal load known to the economic operation of power plants, as electrically operated pumps running day and night know no peak loads. Hence the cheapest power rates are found most highly lucrative to the power plant owner. A scientific study of the trend of modern irrigation development points inevitably to these methods in almost inconceivable applications for future irrigation extension.

One not familiar with local conditions can hardly imagine without going from city to city in this wonderful section of the country the possibilities for concentrated ranching. A ten-acre tract is found to yield such results that only access to the carefully authenticated statistics can convince the investigator of unbelievable returns that are made possible. The untold areas that may be put under cultivation in Southern California make practicable for future extension the utilization of hundreds of thousands of kilowatts not yet developed or even in sight.

Perhaps in no place in the world are to be found better boosters or more people contented with their portion of life than those occupying the orange ranches of Southern California. The concentrated life on these ranches is pleasant, for by means of a lightning operated electric car service leading to a great metropolis, the rancher is practically a dweller in the city and yet posseses all of the open free-aired life of the country. Due to the enormous wealth per acre and the small acreages occupied, these ranches of Southern California present, perhaps, a greater amount of concentrated wealth per acre than any other section of rural life in the world.

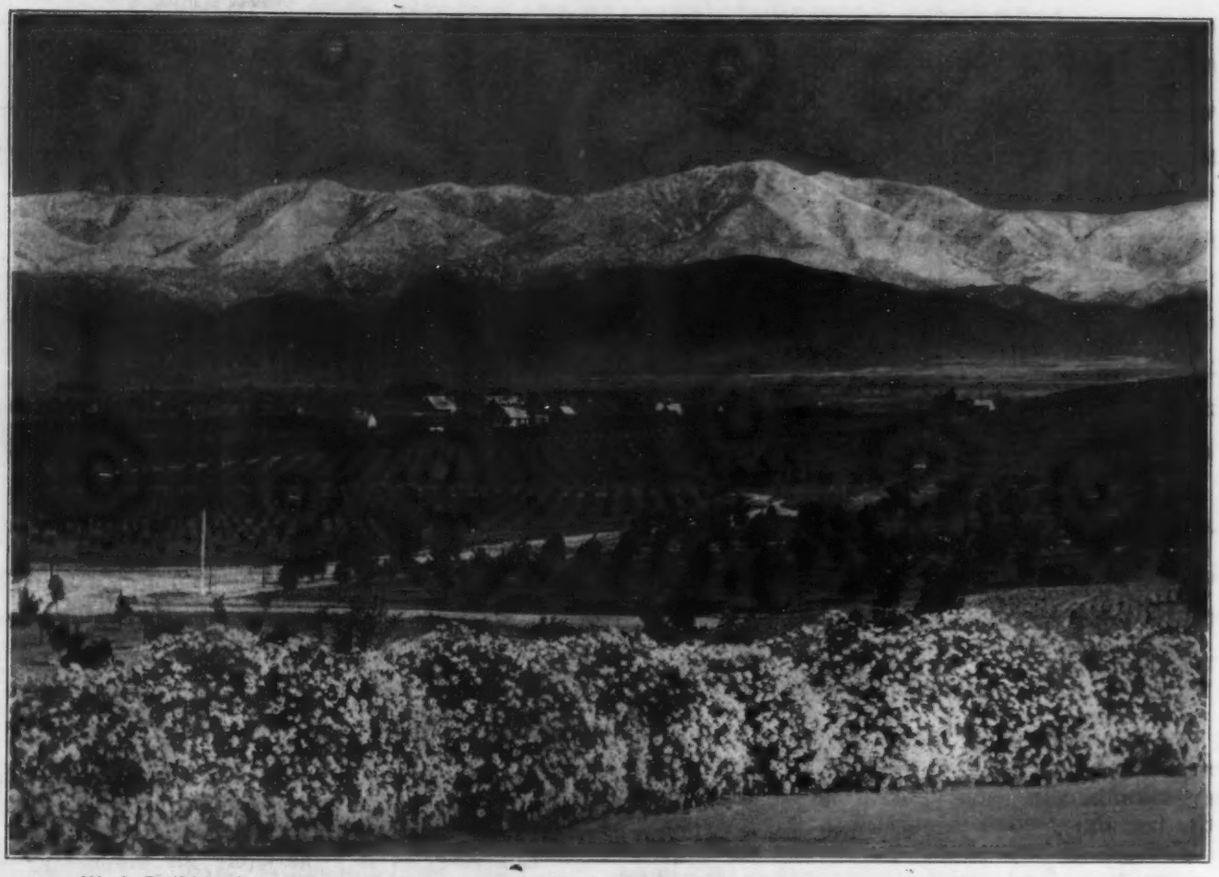
The easily accessible sea beaches add their portion to the enjoyment of the citizens of California. Every phase of enjoyment seems to be open to those on pleasure bent. The clear blue skies, the grand sea plunge, the ships far out on the horizon, the gray sage-brush spotted hills to the east, and the warm surf at the ocean's edge, add every touch of pleasure to one's outing.

Innumerable canyons thread their way up into the high mountains of this section of the country and form the pen-stocks down through which numerous water powers are developed. As one winds his way up in these canyons he is overcome with the exquisite beauty of it all. Proofs of the charms Nature lavishes here are the summer retreats of the wealthy citizens of this portion of the state. Many of these are tucked away in the picturesque coves along the canyon road. Although they are, perhaps, forty miles distant from the daily business cares of the owner, the week-end finds the automobiles chugging their way up the canyon from the busy city, bringing weary men to these havens of rest, and a brief two hours on Monday morning returns them once again to the busy hurly-burly of mercantile and industrial life.

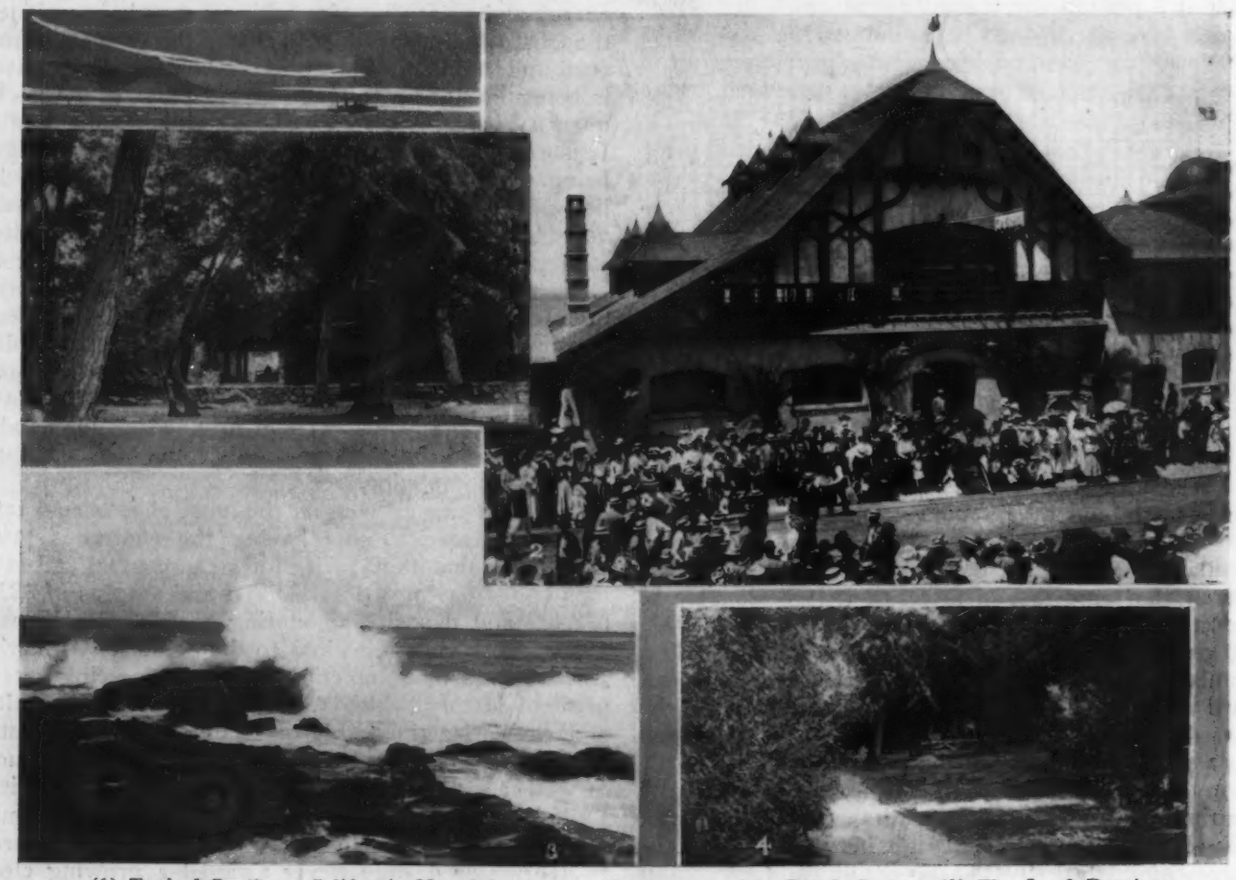
Another feature which has added much to the development of this section of the country is its ideal climate. The remarkable evenness of temperature the year round is shown in the following list of the famed temperature resorts of the world, with it is a statement of the extremes of temperature to be found between January and July of each year:

Melbourne	18
Auckland, N. Z.	19
Cadiz	19
Malta	22
Rome	25
Pensacola	27
Sacramento	27
Cairo	27
Jacksonville	28
Jerusalem	30
Nice	30
Naples	30
Los Angeles	15

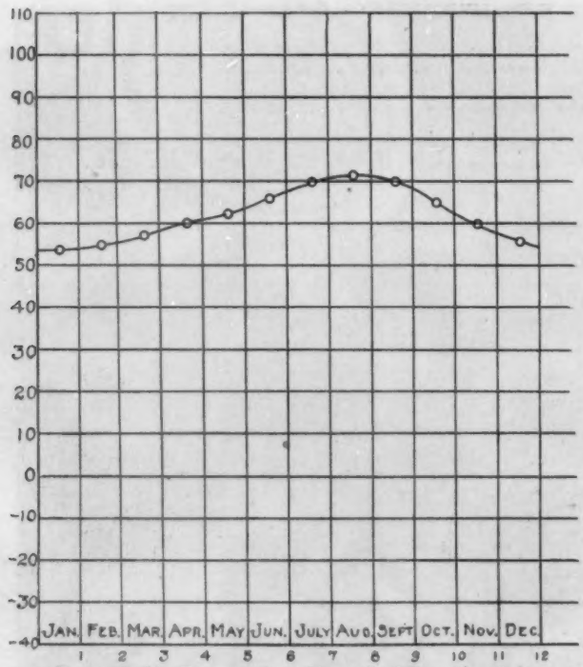
Home Among the Oranges at Ontario.



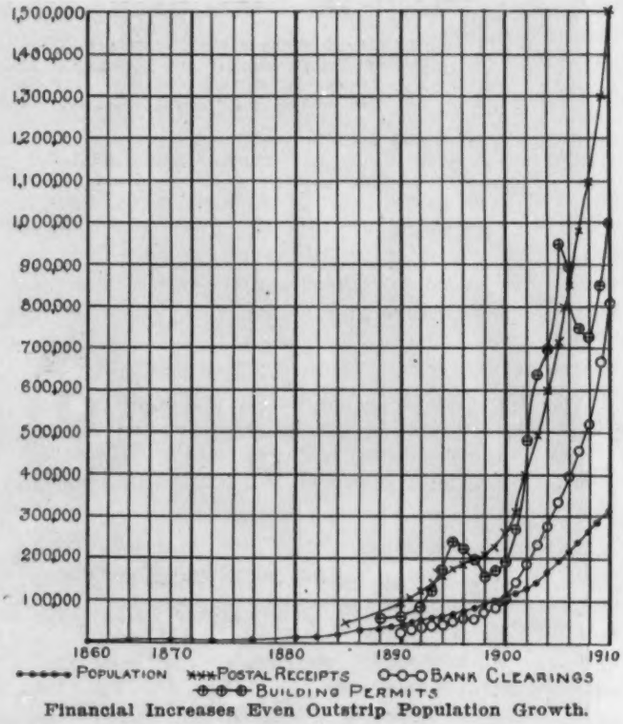
(1) A Striking Scene Typical of Southern California.Marguerites in the Foreground, Citrus Fruits in all Directions and Snow-Capped Mountains in the Distance.



(1) Typical Southern California Mountain Home. (2) Summer Sea Beach Scene. (3) The Loud Roaring Pacific. (4) A Nook in a Secluded Canyon.



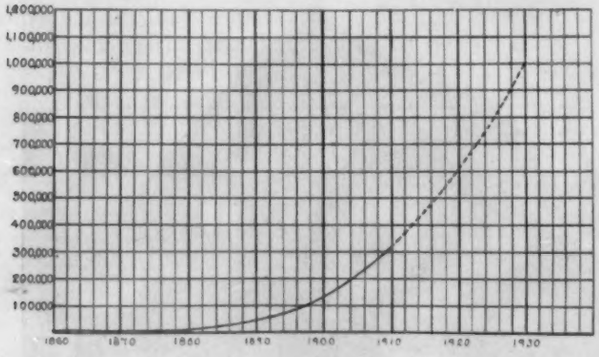
Remarkable Temperature Record of Los Angeles.



Financial Increases Even Outstrip Population Growth.

The accompanying diagram also indicates the average temperature month by month, experienced in this section of the country, according to the records of the last thirty-three years.

The Queen City of the southwest, Los Angeles, is remarkable for two features. The increase of postal receipts and population for the past decade is without a peer in the United States.



One Million Population in 1930—Law of Increase.

A diagram is shown herewith which illustrates this growth, and by extending the main curve along the dotted line according to the law of increase of population, shown by the unbroken line, it is seen that at the same rate of increase, it is reasonable to expect to find in this southern metropolis over 600,000 people in the year 1920, and in the year 1930 a population of 1,000,000 may be confidently looked forward to. Such indications seem incredible. Yet the next diagram shows that this increase in population has a substantial basis, for there is also platted to scale upon this second diagram the postal receipts, the bank clearings and the building permits. The remarkable thing is that as the population increases, all of the above commercial items increase at a far greater accelerating factor. Such an indication shows the stability with which this increase is taking place, and that a firmness and permanency of growth is going on with this unprecedented growth.

Los Angeles is remarkable for the energy and daring of its citizens. It is a place where they dream dreams, yet make good. As an example of the energy and enterprise of its citizens may be mentioned the Los Angeles aqueduct, which is the greatest municipal undertaking in the world. Pure mountain water is being brought a distance of 250 miles in sufficient quantity to supply a city of two million inhabitants. It is a gravity system throughout, no pumping plants being required. The aqueduct will deliver 258 million gallons (net) every twenty-four hours into reservoirs located nearly one thousand feet above the city. It consists of 98 miles of covered concrete conduit, 40 miles uncovered, 21 miles of open canal, 12 miles of inverted siphons, 43 miles of tunnels ten to thirteen feet in diameter, and 4 reservoirs along the line holding three months' supply. Bonds have been issued for this project to the extent of $23,000,000. The total cost will be safely under Chief Engineer Mulholland's estimates, and the work is rapidly rounding itself into shape for completion.

With a city growing at the most phenomenal rate of any in America, now having the enormous total of 360,000 inhabitants; with forty commercial and savings banks having a total capital and surplus of $23,672,429 and deposits amounting to $138,218,417 and annual bank clearings close to the $900,000,000 mark; with the nearby completion of the engineering enterprise of history which will divert with their wealth and enterprise thousands of strangers to her coasts, with an empire of arid lands awaiting the magic touch of water; with an international exposition proclaiming California's praises to the world; with an economic power supply nearby to meet her growing needs, surely a brighter destiny never awaited a growing electrical industry in a fairer empire.

MEMORIAL FOR INTERNATIONAL ENGINEERING CONGRESS

To the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Society of Naval Architects and Marine Engineers, American Society for Testing Materials, Mining and Metallurgical Society of America.

Memorial and Report of Convention of Delegates held in San Francisco, January 15, 1912, to formulate plans for holding an International Engineering Congress in connection with the Panama-Pacific International Exposition in 1915.

Among the great engineering feats which have characterized the years of the last century and those thus far run of the present, there is nothing that approaches in magnitude and boldness the construction of the Panama Canal. When completed and in operation its effect on travel, commerce and navigation will be profound. As a factor in determining the character of the advance in civilization during the twentieth century, its influence cannot now be measured, but its potential importance is entering into all the arrangements for future commerce.

It is a signal honor for the United States of America that it has been permitted to serve as the instrument by which this great engineering work is to be accomplished. Perhaps in no other way could this nation have more significantly impressed its character on a work of world-wide importance.

In this great achievement, no class in this country is more interested than engineers, proud of the men in their profession who are bringing this great enterprise to a successful completion.

The determination to hold on the Pacific Coast an International Exposition to celebrate the joining of the two great oceans has brought to the engineers of the west a stimulating sense of the importance of the work of the engineer as a factor in carrying forward the march of civilization, and mindful of the inspiration and professional uplift to be derived from a concourse of engineers drawn from all parts of the world to one place and animated by one common purpose, they have committed themselves to the undertaking of bringing to the scene of this celebration representative engineers from the great engineering associations of the world in an International Engineering Congress to be held in San Francisco, and during the course of the Exposition.

In the full realization that this can only be accomplished through the various national societies acting in co-operation toward such end, the representatives of such societies in convention here assembled, beg to report with specific recommendations attached, such general plan of organization and management as seems best suited to accomplish the purposes in view.

The type of International Engineering Congress which this convention desires to recommend to the consideration of the national engineering societies which it here represents, may be viewed primarily as a series of meetings of the various American national societies with the participation or co-operation of foreign societies of similar standing, held in one place and with such relation or sequence in time as may best serve the convenience of those desiring to attend

This type of Congress we believe to be the simplest in organization and the most practicable in its relation to the various interests involved. It will secure flexibility of general organization and, to the participating societies, the largest possible independence and responsibility, each in its own field of work.

Having in view a Congress of this type the part which would be taken by each national society in its individual capacity may be outlined as follows:

It will issue in its own name invitations to the foreign societies with which it is most closely affiliated and will be primarily responsible for the duties of host to such as may accept. At the same time such invitation might naturally be supplemented, should the inviting society so desire, by a further official or formal invitation from the Exposition authorities through the special Committee on Congresses.

It will in a similar manner invite, as it may desire, specially eminent foreign engineers to read papers or to take part in the proceedings.

It will be responsible for the procuring of papers, their examination, acceptance, translation where necessary, and printing previous to reading. In this manner each society, acting for itself and in its own field, will assume full responsibility for the scope and character of the papers which are presented under its direct auspices.

It will likewise assume responsibility for final printing and publication of papers with discussion, and as it chooses may effect such publication either as a part of its annual volume or as a separate publication.

These various duties and responsibilities relate to the participating societies individually and are not shared with any other committee or body.

Scope of Congress.

This Convention recommends that the scope of the proposed Congress, as determined by the number and character of the societies invited to participate, be determined by the seven national societies to which this report is primarily made, acting conjointly in such manner as may be hereafter determined.

Other Duties and Activities.

In addition to the preceding outline of suggested duties and activities inhering the national bodies themselves, either individually or conjointly, there will be certain further general duties and activities which must be shared among the participating societies or delegated in some measure to a representative committee.

Such duties may be briefly noted under the following three heads:

(1) Local Committee Activities.

(2) General Publicity.

(3) Social Events, Excursions and like attentions to foreign visitors.

It is clear that in carrying to a successful issue an undertaking such as the proposed Congress there will

be required a strong and widely representative local committee.

This convention recommends that the nucleus of such a local committee should consist of an executive committee comprising three representatives from each of the participating national societies, such representatives to be appointed by the Council or other appointing power of each society, having in view such nominations or suggestions from its local members or branch as they may desire for their information or guidance.

The general duties of such a committee are sufficiently evident from its name. It will have no authority to speak for any national society except as it may receive direct authorization to do so. It will serve primarily as a link between the Exposition authorities and the various national societies, and will in general endeavor to correlate all efforts and interests of a local character toward the success of the undertaking.

Program of Meetings.—Each society will naturally prepare and be responsible for the program of its own meeting. It will be desirable, however, to secure something in the nature of a program of meetings, simply to insure the entire series with a reasonable total time of perhaps fifteen days, without lost time, and in such sequence or concurrence as shall be mutually most agreeable.

Such arrangements would most naturally be made through the local executive committee acting as an intermediary between the various societies and the Exposition authorities, and as a general clearing house for all such matters as may affect the various societies in a collective sense.

Joint or Mass Meetings.—While papers generally will be presented under the auspices of the society which has secured their preparation, it is not unlikely that it may seem desirable to hold certain joint or mass meetings or assemblies at which distinguished foreign engineers or others may have the opportunity of addressing a larger audience than might attend the meetings of a single society. It may seem desirable to open the Congress with some such meeting.

Such details may readily be arranged by the suggested local executive committee, which will act in this regard, as in all others, on behalf of such groups of societies as might desire to make such arrangements.

Publicity.—Regarding publicity, the local committee will naturally be expected to look after such part of this program as may relate to the Pacific Coast in general, California, San Francisco and the Exposition itself.

In addition, each national society will naturally take such steps both officially as a body and individually through its members, as may serve most effectively to bring the matter to the favorable attention of its own members throughout the country, and in particular to that of such foreign societies as it might naturally be expected to invite.

Social events, excursions, etc., will naturally be arranged by the local committee, acting, however, in co-operation with the various national societies, and as their direct agent in the case of any special arrangements which they may desire to make.

Finance.

The various participating societies will naturally provide, each in its own way, for such expenditures as may be necessary to carry out its own individual part of the program as outlined above. In addition, there will be need of certain general funds, especially for the activities of the local committee.

This convention does not recommend any specific plan for providing such funds, believing that it may be safely left as a detail to be later determined, in case the proposed outline plan of organization secures general approval.

For social events, excursions, etc., it will be necessary, presumably, to depend largely on private contributions. This also is a detail which is left for later consideration.

Time of Proposed Congress.

This convention has considered carefully the question of the time of year most suitable for the successful holding of a Congress such as that proposed, and begs to report that in its opinion the month of September (more exact dates to be later determined) will prove the most acceptable both as to climatic conditions and the general personal convenience of those who will desire to attend.

Assembly Rooms for Meetings.

This convention has received through representatives of the Exposition authorities, authorized to speak for its President and Board of Directors, full assurances regarding the adequate provision, free of all expense, of suitable assembly rooms, convention halls, etc., as may be required for a Congress such as is herein contemplated.

These assurances in written form are contained in a letter addressed to the convention by the Chairman of the Board of Exposition Directors and fully empowered to give to this convention assurances regarding such assembly and meeting rooms, and regarding the cordial co-operation and support which the Exposition authorities will extend to such a Congress within the limitations indicated in this communication, a copy of which is hereto attached marked "A".

In conclusion, this convention desires to report and to recommend to the national societies here represented in brief, as follows:

(a) It is the sense of this convention that it is highly desirable to hold in San Francisco in the month of September, 1915, an International Engineering Congress.

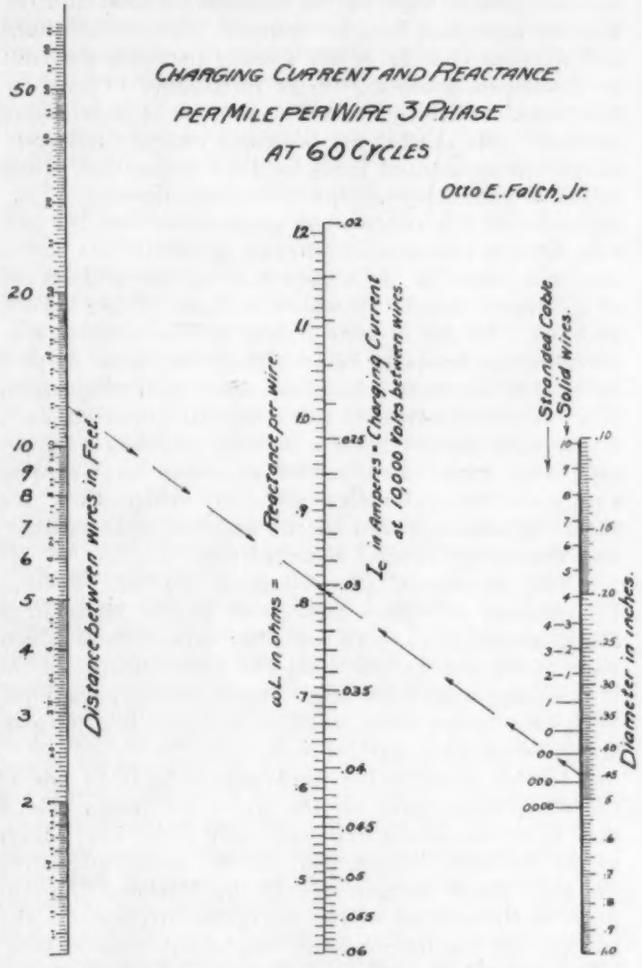
(b) It is the sense of this convention that the general plan of organization and management herein outlined is that which will prove best adapted to this purpose, and such plan is therefore recommended to your favorable consideration.

(c) Should such outline plan meet with your approval this convention begs to recommend prompt action on the appointment of the proposed local exacutive committee as herein suggested, and early consideration of ways and means to provide for the clerical help and other expenses necessary to make its work effective.

SIMPLE METHOD FOR FINDING TRANSMISSION LINE REACTANCE.

BY OTTO E. FALCH, Jr.

The accompanying chart gives a rapid method for finding the charging current and reactance of transmission lines. It consists of four scales, one showing the distance between the wires in feet, one showing the reactance per mile, one the charging current at 10,000 volts between wires and the last the various sized copper wires, whether standard cable, solid wires or hemp core cable. The arrow lines show that a .45 in. hemp core copper cable with a 12 ft. spacing has a reactance of 8.15 ohms per wire and a charging current of .0303 amperes per mile of 10,000 volts.



For a 104,000 volt line 136 miles long the reactance consequently becomes 111 ohms and the charging current 42.8 amperes at 60 cycles per second, the equivalent of 7730 kilowatt amperes. Other problems are similarly solved by connecting a straight line from the size of wire to the spacing and finding the values sought at the intersection.

This chart is a modification of that published in the Feb. 10, 1912, issue of this journal.

Splicing the Pacific Cable, which snapped on the reefs off the Midway Islands, is to be tried by the British cable steamer Restorer, which left Seattle this week. At Honolulu a crew of Kanaka divers with their surf boats will be taken aboard to assist in the difficult task of grappling for the cable.

THE POSSIBILITIES OF CO-OPERATION.

BY PHILIP S. DODD.

During the great Jovian celebration at New York City, Philip S. Dodd, director of publicity of the National Electric Lamp Association and secretary of the Commercial Section of the National Electric Light Association, outlined briefly the work which had been done and which was being done by the Commercial Section, mentioning the value of the reports which had been prepared by the Commercial Section Committees last year, and the value of the two publications, "Data on Electric Signs" and "The Electrical Equipment of the Home" for the development of the industry along educational lines, and their value as a force in the education of the public concerning things electrical. He explained that the plans of the Commercial Section for the coming year embodied the preparation of at least three other publications along similar lines, which would be prepared for general distribution to assist the central stations and manufacturers in the development of their business. Also that the plans of the Section embodied the compilation and distribution of a "Cumulative Commercial Index and Digest" for the benefit of the commercial men in the industry. The digest to contain a complete catalogue of current consuming devices together with data relative to their various constructions and installations, and abstracts and digests appearing in the technical press.

Also that the Section had planned for an advertising exchange which would give to its members the best thought in the country pertaining to advertising and developmental campaigns for use of business-getting departments.

With regard to the New York Jovian Luncheon meetings and various other local organizations of similar character, he made a strong plea for the commencement, by these organizations of definite, practical work for the development of the industry as a whole, illustrating forcibly that where organizations of this character were conducted along the lines of merely passive co-operation, that the interest in these organizations was apt, in the course of time, to lag, but that in each case where active, aggressive work had been taken up, the organizations were not only of much greater value to the industry, but that the interest and enthusiasm was retained and greatly strengthened.

He suggested, and the suggestions were later carried out, that two committees be appointed for the commencement of real work: one the ways and means committee to prepare plans for the definite organization in the City of New York, and a further committee to take up and start, if possible, the co-operative electrical page.

The largest Diesel engine yet built for stationary work is that of 2000 to 2400 horsepower, manufactured by Sulzer Bros. of Winterthur, but it is now stated, however, that an order has been placed with the same firm for four 4000 brake-horsepower engines destined for electric driving in Chile. These will be of the six-cylinder type, working on the two-cycle principle, and their design will be practically the same as that of a marine engine of the same power without the reversing gear. Crossheads will be employed, and it is intended that the engines shall be rendered as simple as possible.

WATER POWERS.

BY. J. C. RALSTON.

In the course of an address delivered before the Northwest Mining Convention at Spokane, Wash., February 15th, 1912, are forcibly stated some plain facts about the Federal resistance of water power development in the West.

It is our purpose to briefly inquire into the theory underlying the use of this great National asset, and into the perversion of that theory as we now unfortunately find it.

The Congressional Act of 1866 throwing the public domain open to mineral location, the Pacific Railroads Bill, the great territorial acquisitions to the United States, the Public Land Laws and the Carey Act were all based upon the theory of encouragement and national development.

It was not until this great group of Legislative Acts made its vitalizing influence felt throughout the country that the nation put away its swaddling clothes and stepped full-panoplied into the arena of world powers. It was not until the fruits of such an internal policy were gathering that the Nation put its monetary system, like the other great nations, upon the gold basis. It was not until the Pacific railroads fostered and encouraged by the Federal Government, were in their fullest operation, that it was possible to enforce the otherwise inert Monroe Doctrine. It was not until our mineral resources were copiously producing that the the Nation could remit a Boxer Indemnity; not until our lands and forests were intensively producing that we could come forth as a champion of the weak and compel Spanish righteousness. It was not until a splendid measure of National prosperity prevailed, attaining its fullest magnitude when National encouragement flourished, that it was possible for an American Navy to circumnavigate the earth.

Amongst the logical incidents of a universal Western development came the need for mechanical power. Coal there was in plenty throughout the Eastern and Middle Western States; but the measures of the West were less plentiful and less pure. Nevertheless, what the Western States seemed to lack in accessible coal reserves was munificently made up in a vast number of great natural water powers. If the laws of Congress were the means of creating a colossal empire of agricultural and other industries, not the least of those industries being power, then it must follow, unless the Nation is to stultify itself, that this water power industry must be developed upon the same theory as were the primal industries from which it sprang. Not that this industry, as such, is a child in need of special or privileged encouragement, but since its development is as essential to the fullest well-being of the West as a dependable fuel supply, it cannot and will not develop under the blighting theory of discouragement and strangulation. The industry promises to become, indeed has already become, one of the important links in National development.

The necessity for economical power is tantamount to the necessity for economical transportation. Power, like transportation, cannot be doled out with a wheelbarrow, but only by the aggregation of large plants economically operated and permanently built upon permanent titles, safeguarded in their rights and encouraged by intelligent and unwhimsical laws, can they meet the demand which a growing country must require.

If hydro-electric power usurps a part of the field which coal previously served, that usurpation is benign and is the highest form of conservation because the coal is saved and the wasting waters are put to beneficial use. If the coal measures of the Eastern States feel aggrieved, and are suffering for a Western market, well and admirably must their hopes find encouragement in the present bureaucratic restrictions upon Western power sites. But perish the thought —it is untenable. Yet curiously by an innocent corollary, the less water power there is on the market the greater must be the demand for coal and oil. It is an historical fact, incidentally, that the Western and Alaskan coal fields not already patented may not be developed excepting under formidable Federal restrictions. Thereby follows another embarrassing corollary; the market for the coals that are now produced from patented lands is daily expanding, while prices are foolishly sympathetic with demand. Furthermore, it is a noteworthy coincidence that the private owners of coal and oil lands generally are active and outspoken in their approval of the withdrawal of all public domain on which coal and oil are known to exist. If the present policy of the alleged conservationists tends to restrict the rival fields of production or to create a handicap upon such production, it needs no economist to translate that important fact. If the same policy seeks to further establish a handicap upon water powers,—an admitted rival of privately owned coal mines and oil fields,—then we secure a clearer vision of the political conservationists' desire for Federal strangulation.

The permanent administration by the Federal Government of water powers or public lands in a State, sovereign as to all functions except those which were delegated to the National Government, is an interference with State affairs never before attempted. Such an attempt must result in a carpet bag bureaucracy, obnoxious and putricent.

In this country the fundamental basis of law is that the States have all the sovereign power which they have not surrendered expressly or by implication to the National Government. In the matter of waters the only power surrendered to the National Government is the control of the navigable streams for the purpose of maintaining and improving their navigability for the benefit of interstate commerce. The Supreme Court has time and again determined that the waters belong to the States and not to the National Government. In accordance with this principle every arid State in the union has enacted laws governing the use of water for irrigation and power purposes, and the Supreme Court has sanctioned such laws. It has held that such laws have always been in existence as laws of necessity.

The man who first applies the water to beneficial use for irrigation or power is universally recognized as having priority of right to the flow of that water. The Federal officials now recognize the ownership of the water in the States, but in order to secure jurisdiction they claim that inasmuch as the Government owns the lands lying along our streams they will not grant a permit or right of way to a power company

to conduct the water over that land and by a sharp descent send it back to the stream, thereby generating power, unless the owner of such power plant agrees to pay a royalty on the water and until he agrees to certain other discouraging bureaucratic terms. This is simply doing indirectly what the Government cannot do directly. It is annulling the inherent power of sovereignty in the States called Eminent Domain, by which rights of way can be condemned for public enterprises.

Under the guise of Conservation the political conservationists have so grossly misrepresented the facts that a credulous public has come to believe that the theory and policy of our Government should be entirely reversed; that the title to water powers, coal, oil and phosphate lands should be held in perpetuity by the Government, and that the right to exploit them should be through leases. There is just as much reason why they should include agricultural lands, but they well know that such an attempt would mean political oblivion to the Palladine of Conservation.

Among the proposed bureaucratic terms, certain Federal taxes are now fixed by the permits for the use of State waters. Time will not now permit of a full discussion of those taxes, but a few of their salient features may with propriety be pointed out. The terms of the permit impose a tax upon the output of the power plant. This tax is so ingeniously devised that if a man installs a highly efficient plant he must pay a higher conservation charge than the man who wastes water by the installation of a cheap, inefficient plant. Furthermore, the man who sells power at a low price must pay a greater tax than the man who sells at a high price. The man who transmits his power over long distances, as is so generally done in the West, must pay for all his transmission losses and therefore pays a greater tax than the man who sells his power at home. This leaves centers remote from water power to turn to other and perhaps much more expensive means, thus stultifying the theory of National Development. Again, if "forest control" adds 25 per cent to the value of water power, a tax of 4.2 per cent of the gross receipts is a tax of 21 per cent of the gross value contributed by the forest. These figures of taxation are cited by Mr. Lewis B. Stillwell, past president of the American Society of Electrical Engineers, as fairly typical within the schedules now demanded. Any yet this new Heaven and new Earth are announced from Washington with the same irresponsible nonchalance as if our Napoleons of Conservation were buying a five-cent cigar.

It must therefore be evident to him who runs that whereas by virtue of a benign and fostering policy on the part of the Federal Government, wherein the boundless West leaped from infancy to adolescence under the theory of encouragement and National development it now finds itself struggling for life under the antithesis of that theory which is expressed by discouragement and strangulation.

While it is too often customary in these days of Bureaucratic Nostrums to condemn without offering reconstruction material, the speaker desires to offer as a substitute for the present form of "Power Agreement" now enforced by the Forestry Service, the following:

1. The Government should make grants to responsible parties on an intermediate franchise plan similar to that adopted by the State of Wisconsin for franchises for public utility companies. This would be a grant practically during good behavior,—the question of good behavior to be subject to review by the courts only. The Government should retain the right to regulate service and rates, in case the State in which the property lies neglects to provide for such regulation. Probably where the property lies within more than one State, or where the business served is interstate business, the Government should retain jurisdiction in its own hands. This plan will accomplish all that the advanced conservationists can hope to do, while at the same time making it possible to obtain private capital for such enterprises.

2. No rental should be charged for the concession. The reason for this provision is that in the first place if the enterprise is able to pay a rental it should take the form of a reduction in price for the power sold, which gives the benefit directly to the consumer, whereas if a rental be charged it becomes an indirect tax upon the consumer for the benefit, not of his community, but of the Federal treasury. The people of the West feel that in view of the fact that practically all eastern water powers are in private hands and pay no taxes to the Federal treasury, the West should have the benefit of its water powers for the localities in which they exist.

Where streams are improved at the expense of the Government or State, the power should be reserved to the Government to assess the power companies occupying sites upon the river affected, for the reasonable benefits conferred by said Government improvement, the assessment to take the form of an annual interest charge payable to the Government or State.

It would probably be desirable to extend this last named feature to the extent that if a private corporation makes an improvement upon a stream which will benefit not only its own property but other property upon the stream, some means should be had of compelling the sharing with it of the cost of said improvement among the other parties benefitted.

It might be provided that in case the lands thus granted shall later be required by the Government for its own use, that the grantees be compensated for the reasonable value of the improvements which they have made upon the sites, and for such improvements as they have made which, while not situated upon the Government sites, are nevertheless, dependent upon said site for their usefulness, as an example, transmission lines connecting the power plants built upon Government sites with the market which they supply, whose usefulness would be entirely destroyed if the site were compelled to be abandoned.

A comparatively short term of franchise on any such sites should not be seriously considered as they will undoubtedly stand in the way of the development of the power resources of the country, and the sinking fund necessary for the retirement of the capital invested within the term of short-term franchises would add so materially to the cost of service to the consumer that it would be very objectionable, and it seems to me altogether unnecessary.

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Business Activities

The recent published list of bank clearings of the coast cities as compared with those of a year ago indicate that an enormous increased volume of transactions is taking place somewhere in the West to cause all this money to change hands. Unquestionably the early future will see a marked betterment in coast conditions. The eternal sound of the Panama canal shovels, eating their way through the connecting link of two continents, serve but to warn us all of the near approach to completion of this project of the ages. Somebody, somewhere, must get busy and the wise ones on the coast are preparing to spike their share in the new commercial readjustment.

The Call of the Engineering Societies

An enterprise, having for its purpose the nation-wide celebration of the completion of the greatest engineering undertaking known to the civilized world, may well entertain the highest ambitions and aspirations. So peculiarly significant of the project it commemorates, is the holding of an international engineering jubilee at San Francisco in 1915, the memorial to the great national engineering societies, found elsewhere in these columns, is certainly fitting and timely.

The American Institute of Electrical Engineers has already taken definite and positive action in the matter of holding an international electrical congress at San Francisco during September of 1915. It is to be hoped that the other societies will take similar action at an early date.

The proposal set forth in the memorial outlines a method of committee representation for a general inter-society conference, which is complete and should prove effective in every respect.

A little over two years and a half now remain before the Panama-Pacific International Exposition will be in full swing. Engineers, the world over, must be communicated with in the planning of the program for this great gathering. Months must be spent in the preparation of papers after the noted speakers are engaged. In the absence of the proposed world's greatest wireless station at San Francisco, it is to be hoped that, although slower speed is necessitated in delivering the invitations, force will not be lacking in bringing about an immediate and definite affirmative answer to this urgent invitation.

The Electric Motor Truck

The recent announcement that the largest automobile company in the world is to build immediately in California a branch factory that will cost $300,000 and be capable of turning out 5000 machines a year is interesting to coast engineers. The West seems to figure in the rise of all great industries of the day. The citizens of California possessing within their borders over one-tenth of the

automobiles of America, may well be wooed by these great interests.

The automobile as a pleasure giving mechanism is unquestionably in a class by itself. But the other side, the commercial end, in which the electric motor truck is beginning to play such a leading role in the congested districts of our western cities, is the phase which so deeply interests at present those of us who are engaged in affairs electrical.

The recent San Francisco meeting of the Electrical Development League was of much interest to all those either taking part or listening to the discussion. There was no point brought up, however, of more intense interest than the announcment of Geo. C. Holberton, general manager of the San Francisco Gas & Electric Company that parties stood ready to pay an amount of money equivalent to 16 per cent on the investment for any one who would furnish $45,000 to purchase electric motor trucks for the use of a certain firm in San Francisco.

New uses and new industries are constantly arising which each day give broader applications for sale of electrical energy. None, however, are more promising than the rapid rise of the electric motor truck.

The Relief of the Earth-Bound

The water-fall with its bountiful provision for human needs delights and touches the heart of man with a beauty indescribable—a beauty not of a picture painted on canvas but rather a beauty which enters the innermost recesses of human yearnings and longings where dwell those qualities that entune man with the Infinite.

Such a beauty overcomes the power expert when he views from some point of eminence the hundreds of miles of drainage area, feeding the rushing rivers which hurry onward in their flight to the loud roaring Pacific. The deep canyons no longer appeal to him as mere masterpieces of nature for ornamental use, but now he sees in them prospective tunnels, overhanging flume lines, siphons which will cross the intersecting canyons and a thousand other engineering structures which will aid him in harnessing these untold powers and making them of use to his fellowmen.

One of the characteristics which distinguish the human being from the other members of the vertebrate family—the ox, the cow and the ass—is man's ability to utilize the forces in nature and make them obey his will and pleasure. The followers of Zoroaster in the early dawn of history, inspired by the seeming inherent divine powers of the flame, worshipped the heat-giving fire as an ever-present god. The Phoenicians, in their wind-propelled ships, sailed the unknown seas, thereby gaining for their civilization prowess and world knowledge. The great powers latent in the falling of water have, however, in order to bless mankind with their presence, awaited the modern development of electrical transmission of energy.

The mere question of being able to harness these powers and deliver them at a profitable figure is to the true engineer but a side issue. It is rather the thought of being able to utilize these waters over and over again for hundreds of years to come that holds him spellbound in his work. As he straps on his high-legged boots and throws his mountain transit over his shoulder, he dreams these dreams and, as the packtrain with its burdens securely fastened by the "diamond hitch," trails its way up through the long winding canyons to the distant reservoir lakes above, again he dreams of the good he will be able to accomplish for his fellowmen. The beauty of it all is that no matter how many water powers he harnesses, no matter how many canyons he reservoirs, like the widow's cruse of oil, his power supply will never diminish, but year after year continue to pour its blessings in the way of light, heat, and the other comforts into the heart throbs of the busy business centers a hundred miles away.

The last ten years have added a new impetus to western life. No longer our young men from the eastern colleges and universities flock out to the mountain ranges and deep valleys for the purpose of sifting the sands for gold. Now comes a stronger, sturdier class of prospective citizens, young men ambitious to be factors in the development of the great waterpowers of our Western Empire. From snow-capped Mt. Rainier in the north to our sun-lit deserts in the south, our mountain districts seem to be teeming with these young men. The result is that every crooked turn in our rivers, every waterfall with its rainbow hue, every mountain lake with its wild game and fish, has been explored, mapped, and reported upon as to future power possibilities.

The granite reef a mile through its heart, the overhanging cliff studded with rocky pinnacles, and the desert with its burning sands have seemed to offer no obstacles to the advance of the great trend of power development.

Many have said there is no study more sublime than astronomy, which tells of worlds millions of miles away. Yet as we gaze upon the masterpieces of engineering accomplishment, of rocky dams running into the hundreds of feet vertical, tunnels conveying water five miles through the rocky pinnacles, flumes constructed along sheer cliffs, pen-stocks, taking their waters from a point almost invisible in its vertical distance above, we are overcome with the awe-inspiring accomplishments that confront us.

A celebrated artist, in his endeavor to portray the burdens and cares of the human race, painted a picture more eloquent than words, setting forth the manner in which every member of the human race is held bound to the earth. His painting is called "Earth-bound" and pictures the old man, the young man, the woman and the child supporting a crushing weight, which pins them to the earth. The men are endeavoring to share the child's part of the crushing burdens and in a measure to share the woman's while the woman is also supporting her share of the burden and endeavoring in addition to share the child's.

No artist can picture the influence the harnessing of the subtle forces of nature is having upon the human race, nor can he point the extent to which its burdens are now being alleviated. Suffice it to say that it requires no stretch of the imagination to prophesy that with the highest development of the water fall and its captive power will eventually come the relief of the "earth-bound."

PERSONALS.

C. C. Cooley, representing a wire manufactory of Trenton, N. J., is among the recent arrivals at San Francisco.

C. C. Hillis, Pacific Coast branch manager of the Electric Appliance Company, has returned to his headquarters at San Francisco from the East.

Samuel G. McMeen, general manager of the Mount Hood Railway, Light & Power Company, of Portland, spent the past week at San Francisco.

F. O. Blair, formerly with the Missouri Pacific Railway Company, has been employed by the city commission of Chehalis to act as city engineer.

C. E. Groesbeck, who represents the Western States Gas and Electric Company, with headquarters at Portland, was a recent San Francisco visitor.

S P. Russell, manager of the electrical department of H. W. Johns-Manville Company's San Francisco branch, has returned from an Eastern trip.

R. Leo Van der Naillen, general manager of the Oro Electric Corporation, is at Oroville on business connected with the proposed hydroelectric development.

F. B. Gleason, manager of the San Francisco branch of the Western Electric Company, is at Seattle to meet Mr. Bennis, an official of the company, and accompany him to California.

P. H. Affolter, manager of the electrical department of Fairbanks, Morse & Co.'s San Francisco house, has returned from an extensive Eastern trip, in the course of which he visited the various factories.

Charles W. Waller, who is interested in the California Consolidated Light & Power Company, which operates electric power and traction plants at Monterey and Salinas, is at New York City on business.

John Coffee Hays, general manager of the Mount Whitney Power Company, arrived at San Francisco from Visalia, during the past week, in company with John Hays Hammond, with whom he is interested in hydroelectric enterprises.

Among the San Francisco electrical representatives who recently visited Los Angeles on business were: Miles Steel, of the Benjamin Electric Company, H. B. Squires of Otis & Squires, and S. B. Gregory of the Arrow Electric Company.

H. E. Grant of the British Columbia Electric Railway Company, recently delivered an inspiring address on "Some Notes on Opportunity in the Electrical Industry," before the Vancouver Section of the National Electric Light Association.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, returned to San Francisco during the past week after a business tour of Southern California. He expects to start something among the Rejuvenated Sons of Jove very shortly.

Arnold Pfau, hydraulic engineer for the Allis-Chalmers Company, who recently arrived at San Francisco, has gone to the Seattle office of the company and will make tests of the new hydroelectric plant of the White River Power Company at Sumner, Wash., before he returns to California.

J. J. Pottinger, formerly sales manager with the San Francisco offices of the Westinghouse Electric & Manufacturing Company, has become sales manager of the Mechanical Installation Company of 189 Second street, San Francisco, who will specialize on electrical construction and repair work, as well as second-hand electrical machinery.

H. L. Jackman, general manager of the light and power interests of the Western States Gas & Electric Company in Humboldt County, spent the past week at San Francisco purchasing steam turbine equipment for the Eureka generating plant, which is to have its capacity doubled at once. The contract for additional condensing apparatus was awarded to Hunt, Mirk & Company.

John Martin, who is interested in the Coast Counties Power Company and the Midway Oil Company, has returned to San Francisco from New York accompanied by Mrs. Martin.

Herman von Shrenk, formerly of the forestry department, at present a consulting engineer of St. Louis, a leading authority on creosoted wood pavement, has been spending a few days in Tacoma in connection with the creosoting plant to be erected by the St. Paul & Tacoma Lumber Company.

PACIFIC COAST A. I. E. E. NOTES.

The Portland Section discussed "Preservative Treatment of Poles" on February 20.

The Los Angeles Section discussed "Gas Power" with special reference to the gas producer on February 20.

The San Francisco Section considered "A Cable Crossing of San Francisco Bay" on February 26.

The Board of Managers has granted the request that a Branch be established at the University of California.

CALIFORNIA ELECTRICAL CONTRACTORS' NOTES.

The John G. Sutton Company are doing the electric work in the Nickle residence at Sacramento and Laguna streets for $1920. Henry Meyers is the architect.

Seth Cohn, a popular electric contractor of San Mateo, had his collar bone broken when his horse ran away last Sunday. He is doing as well as can be expected, but will be confined to his home for some time.

The Turner Company have been awarded the electrical work on the building on the south side of Geary street, between Polk and Larkin, for the Sheehy estate, according to plans and specifications, for $2600.

The power committee of the California State Association of Electrical Contractors meets at Bakersfield Sunday, February 25, to discuss ways and means of bringing closer relations between central stations and contractors for the mutual benefit of both.

The findings of this committee will be forwarded to the executive committee of the National Association of Electrical Contractors, which body will early in March meet a committee from the National Electric Light Association.

The members of the power committee are John Rendler, Los Angeles; H. Miller, Pasadena; J. R. Reynolds, Santa Barbara; Seth Cohn, San Mateo; Phil Levy, San Francisco; C. V. Schneider, Sacramento, and W. S. Hanbridge, San Francisco.

The California Electrical Supply Company, Roy A. Wolden, manager, has removed from 680 Mission street to a new store at 643 Mission street. The California Electrical Construction Company, R. L. Wolden, manager, will remain at its present location, 680 Mission street, San Francisco.

The following notice was mailed to contractors' offices by Wm. J. Nixon, chief of department of electricity, San Francisco, in reference to use of code wire: "This department will rule that, unless work is started on job on or before July 1st, 1912, nothing but new code wire will pass inspection, irrespective of what date application is filed."

TRADE NOTES.

Ray D. Lillibridge, incorporated, technical advertising experts, at New York City, announce the acquisition of the services of Kingsley Gould Martin as engineer and writer. Mr. Martin has secured a substantial interest in the corporation and has been elected its treasurer.

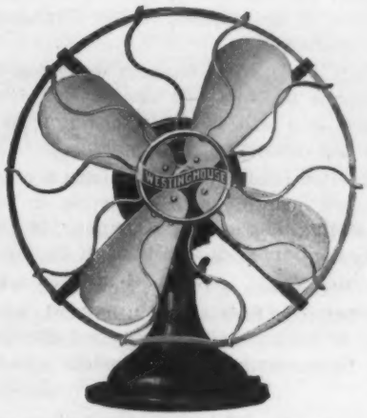
The Standard Underground Cable Company, with Pacific Coast offices in the First National Bank Building, San Francisco, have opened additional sub-offices in the Central Building, Seattle, in charge of C. A. Brown, and in the Yeon Building, Portland, in charge of W. G. Stearns.

INDUSTRIAL

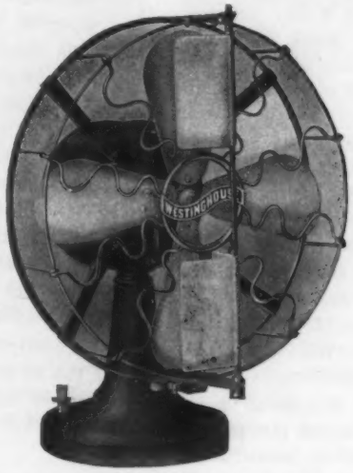
NEW WESTINGHOUSE STEEL FRAME FAN MOTORS.

The introduction this year by the Westinghouse Electric & Manufacturing Company of a complete new line of fan motors with steel frames instead of the usual cast iron construction, bids fair to mark an epoch in the history of the manufacture of a product already having reached such a degree of perfection that further improvements were considered to be only of minor importance.

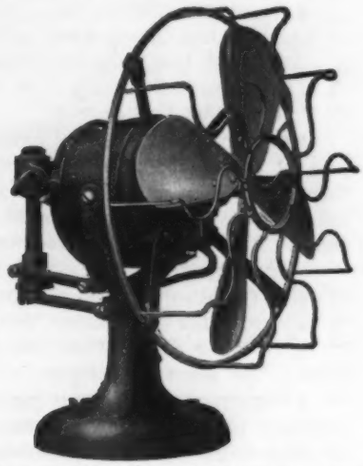
The motor frame, the base and the guard arms are made of drawn steel, instead of cast iron which has been the usual practice for years. Drawn steel combines great strength with minimum weight; these fan motors weigh from 20 to 40 per cent less than cast iron frame fan motors of corresponding sizes and are therefore much more easily handled and less expensive to transport. Moreover, this construction makes these fan motors remarkably handsome in appearance. The steel is drawn into graceful, harmonious lines, its surface is smooth and gives a lustrous finish, and the steel lends itself to a variety of beautiful metal finishes. The standard finishes are black enamel and black oxide, similar to gun metal.



Drawn Steel Desk and Bracket Fan.



Air-Operated Oscillating Fan.


Mechanically-Operated Oscillating Fan

Another special feature of these fan motors is the swivel-and-hinge joint which connects the motor and the base. By means of this joint, the fan can be tilted within 105 degrees or rotated within 340 degrees in any direction and can be changed from desk to bracket mounting without the use of a trunnion, tools, or an adapter. All that is necessary to make any of these adjustments is to loosen a wing-nut; when the wing-nut is tightened the fan is locked in position and can be neither tilted nor rotated.

All 25-30, 50 and 60 cycle fan motors have three speeds and there is a marked difference in the effect of the fan at each speed. The speeds are controlled by a lever in the base of the fan which is firmly held at each running point and does not open the circuit between points. The fans will start and can be operated continuously on any point.

A new line of mechanically-operated oscillating fan motors in drawn steel frames, a further development of the desk and bracket line, will be offered this season. In these fan motors the oscillating mechanism is entirely enclosed; the oscillating movement can be stopped and started while the fan is in motion; the fan can be tilted or changed from desk to bracket mounting without the use of a trunnion or an adapter; and if the fan guard strikes an obstruction during the course of oscillation, the fan merely stops oscillating without interfering with the operation of the motor so that the overturning of the fan or the burning out of the motor is prevented. The wearing parts are readily renewable without using tools. The range of oscillation can be adjusted and the mechanism is packed in lubricant.

Mechanically-operated oscillating fan motors in cast iron frames of the design so successful last season, are again offered. The gears of the oscillating mechanism operate in a closed case packed with grease and require lubrication once a season only. The arc of oscillation can be made 45 degrees or 90 degrees, or the oscillating movement can be stopped altogether if desired.

The air-operated oscillating fan motors offered this year are an improvement over last year's models. The oscillating movement is effected by means of vanes mounted in front of the fan guard; the arc of oscillation can be varied from 30 degrees to 360 degrees, in steps of 30 degrees. The current is carried from the base to the motor through slip rings so that there are no leads to be broken.

A MODERN ELECTRIC SUPPLY HOUSE.

The Pacific States Electric Company of San Francisco, Oakland, Los Angeles and Portland have recently so perfected their sales organization that they are now prepared to fill all orders with the greatest dispatch from their four supply houses. These stocks are among the largest and most complete carried on the Pacific Coast and in them the central station and the contractor will find all kinds of electrical apparatus and supplies ready for immediate shipment.

This company takes particular pride not only in its thoroughly trained selling force but also in the excellent system whereby it handles all orders as received. Thereby they are enabled to give the customer that service which is so essential to satisfaction.

The catalogue and price list of the Pacific States Electric Company is the most comprehensive ever compiled by a Western firm and is invaluable to every electrical man who desires to know "where he can find it in stock on the Coast." The company is anxious to furnish all those not owning a copy of this "encyclopedia electrical" with both the catalogue and the price list, which contains several novel features facilitating its use.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—Continuous Concrete Pipe Company; incorporators, J. B. Carr, George R. Norton, L. W. Bentz; capital stock, $250,000.

RIVERSIDE, CAL.—The Inter-State Telegraph Company has incorporated with capital stock of $500,000. The directors are: P. E. Ellis, James Smythe and William Muller. The company will operate telephone and telegraph lines.

LIBBY, MONT.—J. H. Ehlers, Spokane, has formed the Yahk Power Company to harness Yahk Falls and develop power, which will be sent to Libby and other points. Milwaukee capital is said to be interested with Mr. Ehlers.

SEASIDE, ORE.—The Mutual Telephone Company has been organized by W. D. Torrey, Audley Gregg and Chas. Williams, who received a franchise from the county court to construct a line to the mouth of the Elk Creek River, a distance of nine miles.

SAN BERNARDINO, CAL.—The Stowe Water Company of Redlands has incorporated with capital stock of $10,000, of which $500 has been subscribed by Elizabeth J. Stowe, E. A, Stowe, L. F. Churchill, J. M. Woehr, all of Redlands, and C. F. Bailey of Los Angeles.

ORIENT, WASH.—A telephone company will be incorporated here to be known as the Columbia & Kettle River Telephone Company, which will connect the towns of Rossburg, Boyds, Napoleon and Orient. Fred Shriner, Geo. Lane and W. R. Ward are the directors.

SACRAMENTO, CAL.—The Midland Counties Gas & Electric Company has been incorporated for $1,000,000, by W. G. Crittenden of Berkeley, W. A. Nunlist, J. J. Webb and P. W. D. Webb of San Francisco and J. A. Williams of Alameda. The place of business is San Francisco.

STOCKTON, CAL.—The Tidewater & Southern Transit Company has filed articles of incorporation for the purpose of constructing 172 miles of railroad extending from Turlock to Fresno, and touching with branch lines various points in San Joaquin, Stanislaus, Merced and Fresno counties. Of the total amount the sum of $189,200 has been subscribed. Stockton is the principal place of business of the incorporation and the following are the stockholders: Karl C. Brueck, J. A. Coley, Byron A. Bearce, J. L. Craig, George S. Schuler, Ward B. Minture and T. J. Wisecarver, all of Stockton.

ILLUMINATION.

ALAMEDA, CAL.—The calling of a bond election to raise $125,000 for improving the municipal electric light plant will be considered soon by the City Council.

GLENDALE, CAL.—Lights in West Glendale, for which $40,000 bonds were voted February 2, will be installed as soon as the bonds can be issued and sold.

COLTON, CAL.—The F. O. Lantz Electric Company has been awarded the contract for furnishing the city with electrical supplies with which to install the proposed new system.

LAS VEGAS, NEV.—Kennard Moore has taken the contract to build the new buildings to house the gas and electric plant of Consolidated Light & Power Company, south of town.

TACOMA, WASH.—Commissioner H. F. Gronen reports that the city lighting plant distributing system will be rewired this year to care for the current generated by the new Nisqually municipal project.

TRUCKEE, CAL.—It is stated here that the Southern Pacific Company is preparing for the installation of an electric power plant on the Truckee River for the purpose of furnishing electricity for its yards, shops and buildings here. The dam at the Truckee electric plant went out some time ago and has not been repaired, and as a consequence the lighting service has been poor, there being insufficient power to serve the amount of light that is needed.

TRANSPORTATION.

RONAN, MONT.—The Flathead Power & Traction Company has been surveying for a line from Dixon to Polson.

OLYMPIA, WASH.—The right-of-way between here and Centralia for an electric line by the Washington-Oregon Corporation is being looked up. The road is assured.

MESA, ARIZ.—The Salt River Valley Electric Railway Company has been granted a franchise to operate for a period of 25 years a street railway along certain public streets and highways of the city.

NORTH YAKIMA, WASH.—To connect North Yakima with the Selah and Wenas valleys, construction of an eight-mile extension of the line of the Yakima Valley Transportation Company will be started.

NEW WESTMINSTER, B. C.—The Saanich extension of the British Columbia Electric Railway will have its terminus at Deep Cove. A branch line will be built to Union bay. Wharves will be built by the company at both points.

SALEM, ORE.—A traction road will be built from a point on the Corvallis & Eastern near Mehama or Lyons, to the mines of the Electric Mining & Smelting Company in the Gold Creek district of the Santiam region. Distance, 25 miles.

RAYMOND, WASH.—Sanderson & Porter, New York, who built the street railway between here and South Bend, have taken over the interests of the South Bend-Raymond Electric Company, for $100,000. Improvements to the system will be made.

SAN FRANCISCO, CAL.—The United Railroads is working upon a compromise of Supervisor Bancroft's ordinance to compel the company to operate its Sutter street cars by trolley down the center tracks on Market street to provide for some adequate service.

FRESNO, CAL.—The Stone & Webster Construction Company has established seven camps along the proposed line of the railroad from Gordon Switch, east of Clovis, to Pinnell's station, on the road to Big Creek and work is being rushed with all possible speed.

SAN DIEGO, CAL.—Negotiations are about to be closed whereby New York and Los Angeles capital will build the San Diego, El Cajon and Escondido electric line. Construction will be under way in less than 30 days. George W. Purcell is president and manager of the company.

LOS ANGELES, CAL.—The largest mortgage ever filed in the office of the county recorder is for $100,000,000 and was given by the Pacific Electric Railway Company to the United States Mortgage and Trust Company, a New York corporation, to secure an issue of 50-year gold mortgage bonds, to be issued by the railway company to provide funds for the extensive improvements and the new lines now being planned. All of the real and personal property of the corporation of every description is included in the mortgage—rolling stock, tracks, equipment of all kinds, franchises, rights of way, easements—everything. Of the $100,000,000 to be gotten from the sale of the bonds, $39,693,000 will be held as a fund out of which to redeem outstanding bonds of the various companies recently merged into the Pacific Electric as they mature.

WENATCHEE, WASH.—It is probable the city will give a franchise to the Felt interests for a street railway line here.

SOUTH VANCOUVER, B. C.—The British Columbia Electric Railway will be required to construct a car line between Fraser street and Victoria road.

MISSOULA, MONT.—Condemnation proceedings have been instituted to secure a right of way for an electric line to connect Missoula and Hamilton, a distance of fifty-six miles.

SANTA BARBARA, CAL.—A plan for the complete construction of the Santa Barbara Consolidated street railway system has developed, and at the next meeting of the City Council a proposition for a solution of the problem will be made by Geo. A. Batchelder of Menlo Park, former coast representative of E. R. Rollins Sons, bankers, and Geo. I. Cochran, president of the Pacific Mutual Life Insurance Company. The plan is to ask the city for a 45-year franchise, giving the right of purchase after 35 years, a board of appraisers to set the price. The company also will agree to turn over to the city 2 per cent of its gross receipts. If the council agrees, the company will immediately issue $500,000 in bonds, one-half for immediate needs, and the remainder to be used for future improvements. The bond issue will be secured by a first mortgage on the property of the company and the Southern California Edison Company of Los Angeles will guarantee interest. The holdings of the present bondholders aggregate $163,000. The Southern California Edison Company will operate the road. The intention is to double-track State street and lay new rails on all lines, extending several of them. New rolling stock also will be provided.

TRANSMISSION.

RED BLUFF, CAL.—Red Bluff is talking of calling a bond election for the construction of a municipal water and electric lighting plant.

SPOKANE, WASH.—The International Power Company has filed claims on water power at three points on the Pend Oreille River, and expects to erect a dam and power plant at each.

POCATELLO, IDAHO.—A crew of men is getting ready for the installation of a hydroelectric power plant at Black Canyon, to develop power for the operation of a big flour mill which will be erected this year at Grace.

LIBBY, MONT.—J. H. Ehlers of Spokane states that he has completed all the financial arrangements for erecting a power house at Yahk Falls, 10 miles from where this river empties into the Kootenai. The power generated will be about 5000 h.p., of which 1000 h.p. is to be transmitted 18 miles to Libby for municipal lighting and industrial purposes.

REDDING, CAL.—The Northern California Power Company of this city, which recently purchased its only rival in the northern part of the State, the Sacramento Valley Power Company, will re-establish meters throughout its territory, which embraces Tehama, Shasta and Glenn counties, together with a good deal of Colusa and Butte counties. Flat rates will then be abolished.

SAN FRANCISCO, CAL.—For the first time in history, electric power at 11,000 volts has been transmitted across San Francisco Bay. The Great Western Power Company, which recently laid a heavily armored cable 20,000 feet in length and 3¾ inches in diameter from the Western Pacific Mole in Oakland to the foot of Howard street, San Francisco, successfully transmitted power last week. Power can now be sent across the bay from the City Electric steam plant in San Francisco in case of any interruption to the hydroelectric service from the Big Bend plant of the Great Western Power Company.

TELEPHONE AND TELEGRAPH.

SAN FRANCISCO, CAL.—The McCarthy Wireless Telephone Company has made application for dissolution.

CRESWELL, ORE.—Geo. M. Hawley and Schmitt Bros. have asked for a telephone franchise in this town.

SPOKANE, WASH.—A 20-year franchise has been granted to the Farmers' Inland Co-operative Telephone Company.

EMMETT, IDAHO.—The business men here will immediately organize an independent telephone company to take care of local business.

BOISE, IDAHO.—The ordinance compelling telephone and electric light wires to be placed under ground by January 1, 1913, was passed.

RED BLUFF, CAL.—The Independent Telephone Company is to build an extension to all parts of Tehama County and to have long distance phone from Redding to Sacramento and San Francisco in a short time.

LOS ANGELES, CAL.—For the purpose of transmitting school news from the University of Southern California to and from other educational institutions throughout the State, a wireless station will be built at the local school. It will have a span of 400 ft. and hang of 105 ft. from the ground. It will have a sending capacity of 400 miles and unlimited receiving scope. It will be ready for use in about a month.

WATERWORKS.

EUREKA, CAL.—A special election to vote on water bonds will be held March 11.

UNION, ORE.—Union is about to make $20,000 worth of improvements on its water system, and the question of whether to use wood or steel pipe is now under consideration.

OAKLAND, CAL.—A special meeting of the City Council will be called by Mayor Mott next week for the purpose of taking testimony preparatory to fixing the water rates for the fiscal year 1912-13.

CORNELIUS, ORE.—The town will soon vote on the proposition to bond itself for $27,000 to be used for installing a water system. Should the proposition carry a gravity system will be installed.

TUCSON, ARIZ.—The City Council is investigating the proposition for building an immense reservoir in Tucson Mountain at a cost of $100,000 with a capacity of 50,000 gallons of water. With such a reservoir pumps could be kept running at all hours.

SEATTLE, WASH.—The contract for the construction of a six-foot water main tunnel 50 feet below the surface of Twelfth Avenue South, has been awarded to George C. Deitrich & Co., at $26,636.20. A 42-in. steel Cedar River water main will be laid through this tunnel.

SALEM, ORE.—The City Council has appointed a committee to negotiate with the Salem Water Company regarding the purchase of the water plant operated by that company. Engineers are to make a thorough investigation of the plant preparatory to any final action in the matter.

HANFORD, CAL.—The Hanford Water Company will soon install another pump at its new addition to the main plant. This will be a duplicate of the 200 gallon turbine pump recently installed there. The company also contemplates removing their wooden tanks and replacing them with a steel tank.

SACRAMENTO, CAL.—A plan to furnish the city with mountain water, to be conveyed by means of a gigantic conduit from the summit of the Sierras, will be submitted to the Board of Trustees by James D. Stewart, manager of the United Water & Power Company of Gold Run, Placer County, to cost about $1,000,000.

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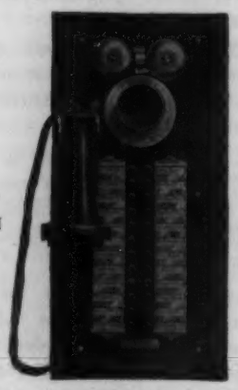

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